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THE DECENNIAL.

The National Electric Light Association is Ten Years Old This Month.

HOW IT CAME INTO EXISTENCE THROUGH THE CALL OF THIS JOURNAL IN THE YEAR 1885 IN THE CITY OF CHICAGO—A REMARKABLY SUCCESSFUL AND INFLUENTIAL ORGANIZATION.

N.E.L.A.
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ELECTRICAL REVIEW
EDITORIAL FROM ELECTRICAL REVIEW JANUARY 17, 1885.
THE ELECTRIC LIGHT CONVENTION.
CLEVELAND ~ FEB. 1895 ~ FRANCISCO.
WASHINGTON ~ FEB. 1894 ~ ARMSTRONG
ST. LOUIS - FEB - 1893 - AYER ~
BUFFALO - FEB - 1892 - HUNTLEY.
MONTREAL - SEPTEMBER - 1891 - HUNTLEY.
PROVIDENCE - FEB - 1891 ~ PERRY.
CAPE MAY - AUGUST - 1890 - PERRY.
KANSAS CITY - FEBRUARY - 1890 - WEEKS.
NIAGARA FALLS - AUGUST - 1889 - WEEKS.
CHICAGO - FEBRUARY - 1889 - DUNCAN. ~
NEW YORK ~ AUGUST - 1888 - DUNCAN.
PITTSBURGH - FEBRUARY - 1888 - MORRISON.
BOSTON ~ AUGUST ~ 1887 ~ MORRISON.
PHILADELPHIA - FEB. ~ 1887 ~ MORRISON.
DETROIT ~ AUGUST ~ 1886 ~ MORRISON.
BALTIMORE ~ FEB. 1886 ~ MORRISON ~
NEW YORK ~ AUGUST ~ 1885 ~ MORRISON.
CHICAGO ~ FEB. 1885 ~ ~ MORRISON.

GREETING TO THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—TRIUMPHANT ENTRY INTO ITS SECOND DECADE.—PROGRESSIVE STEPS OF ITS HISTORY.

The first meeting of the National Electric Light Association was held at the Grand Pacific Hotel, Chicago, February 25, 1885. The meeting was held in response to a call in the editorial columns of the ELECTRICAL REVIEW, of January 17, 1885. A fac-simile of the editorial is presented on this page. Immediately after its appearance the ELECTRICAL REVIEW was informed that it had made a grave mistake, that the parent—manufacturing — electric light companies were opposed to the meeting, and some of them so notified the local illuminating companies using their apparatus. This gave an additional interest to the meeting and attracted to it attention and attendance that it might not have had otherwise. The ELECTRICAL REVIEW remained constant in the belief that the forming of such an association would result in good to all concerned, and continued to urge it. A member of our staff went to Chicago; local committees were formed and worked with enthusiasm, and as a result, 86 individuals attended the first meeting. They were chiefly electric lighting representatives and carbon manufacturers, with a select sprinkling of insulated wire, iron tower, glass, engine and cross-arm representatives. Three electrical newspaper men were present, two from the ELECTRICAL REVIEW, which up to the time of the meeting had not had any assistance from its contemporaries, of which there were only two, and one of these published monthly.

Among the gentlemen of electrical prominence at the time who were present were Prof. Elisha Gray, Wm. Hochhausen, C. J. Van Depoele and Elmer A. Sperry. Edison and Alexander Graham Bell were in Chicago that week, but neither attended the convention.

The convention went to work promptly and continued with com-

mendable industry, holding three sessions the first day and two the second, when it adjourned. Mr. Wm. A. Hovey, associate editor of the ELECTRICAL REVIEW, called the meeting to order, striking the key-note of the occasion in the following words:

"I take it that this convention is held upon the principle that some of us know what others do not. Let us in a friendly way compare notes, tell each other all we know, tell anything that has been a benefit to us and can be to others, and we will all go home with an increased knowledge."

Mr. Geo. S. Bowen was elected temporary chairman, afterwards succeeded by Mr. J. F. Morrison, who was elected president of the Association and served in that capacity for three years. The presidents and the years of their reign and the places of meeting are shown in the sketch on the preceding page.

To attempt even a brief review of the interesting proceedings space does not permit. Suffice it to say they were characterized by snap and energy throughout and the discussions were animated and prophetic, and at times sparkling with humor.

MEN WHO WILL BE THERE.

SOME OF THE GUESTS OF CLEVELAND THIS WEEK WHO ARE ACTIVE IN ELECTRICAL WORK.

A Brief Description of the Various Electrical Interests of the "Forest City"—Preparations for Entertainment.

Cleveland, commonly called the "Forest City," but more properly speaking, the "Convention City," from its immense popularity as a meeting place for representative bodies of business men, will this week extend a hearty welcome to the members and friends of the National Electric Light Association at its eighteenth convention.

Extensive preparations have been made for the reception and entertainment of the city's guests, and the gathering is expected to be the largest and most noteworthy in the history of the association.

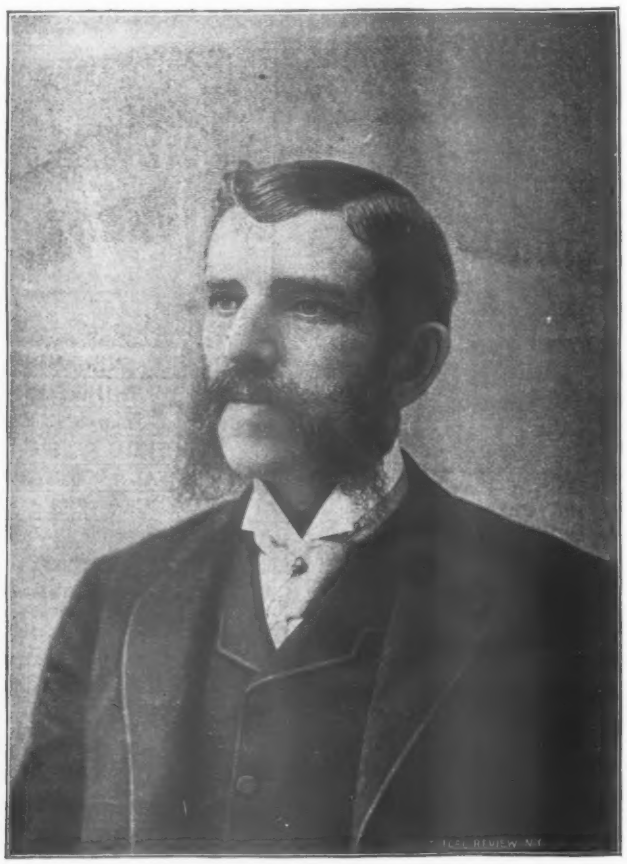
Cleveland's popularity is not to be wondered at when the many advantages she offers are taken into consideration. The central location, magnificent transportation facilities, ample hotel accommodations, to say nothing of the immense manufacturing interests included within her borders, all contribute to make an ideal convention city.

In Cleveland also are centered some of the largest electrical concerns of the country, and electrical development is well represented in her street railway and electric lighting systems.

The Hollenden, which will be convention headquarters, is at the present time a veritable hive of industry, and every square foot of space has been spoken for. While this house is well accustomed to handling large crowds, and conventions of one kind or another are almost a weekly occurrence, it is safe to say that the gathering on the 19th, 20th and 21st will be the largest of the year.

The manufacturing and electrical interests of Cleveland are too well-known to need any detailed mention at this time, but among the prominent concerns whose representatives will be on hand to receive the visiting delegates are the Brush Electric Company, the Sperry Electric Company, the National Carbon Company, the Buckeye Electric Company, the

SECRETARY GEO. F. PORTER.



PRESIDENT M. J. FRANCISCO.

VICE-PRESIDENT FREDERIC NICHOLLS.

H. H. FAIRBANKS, EXECUTIVE COMMITTEE.

JOHN A. SEELY, EXECUTIVE COMMITTEE.

E. F. PECK, EXECUTIVE COMMITTEE.

EX-PRESIDENT HUNTLEY, EXECUTIVE COMMITTEE.

A. M. YOUNG, FORMER EXECUTIVE COMMITTEEMAN.

A. J. DECAMP, EXECUTIVE COMMITTEE.

Walker Manufacturing Company, the Ellwell-Parker Company, and a score of others.

The magnificent plant of the Brush company has already been

C. O. Baker, Jr., Master of Transportation.

fully described in the columns of the Electrical Review, and all are familiar with the apparatus they manufacture. Business is exceedingly

President H. C. Adams, of the Phillips Insulated Wire Company.

good with them at present, and they have recently installed an arc lighting plant which will undoubtedly open up a new epoch in this line of electrical development.

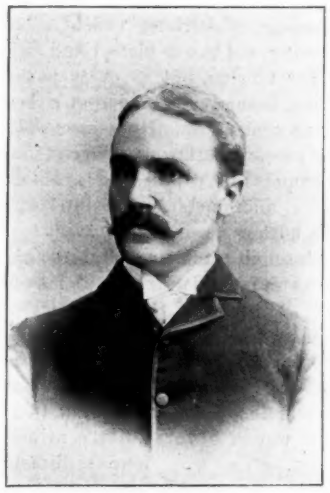
Geo. A. Redman, Rochester, N. Y.

The new plant of the National Carbon Company in Cleveland is the largest and finest in the world, and ranks prominently among the immense manufacturing concerns of the city.

One of the most recent, and at the same time important, additions to the manufacturing interests of the city is the advent of the Elwell-Parker Electric Company of America. This concern was organized a little over a year ago with Cleveland capital and by Cleveland men, all of them being manufacturers themselves. They purchased at the outset all the American patents, rights, franchises, etc., from the English Elwell-Parker Company, known on the other side as the Electric Construction Company of London and Wolverhampton, England. They are, therefore, in a position to place upon the market all the various types of the celebrated Elwell-Parker dynamos, motors and apparatus.

L. B. Stillwell, of Pittsburgh, Pa.

While these machines are comparatively little known in this country, they have been in use since 1881 in all parts of Great Britain, on the Continent, in South Africa, India, Australia and other countries. The company are now manufacturing electric generators of 1,000 horse-



A. J. Wurts.

power and under, motors, transformers, automatic switches and other apparatus for all the industrial applications of electricity, and especially the heavy electric machinery for power and lighting purposes, including long distance transmission and distribution by both alternating and direct current. While the officers of the company are not quite ready to say much about this long distance transmission and distribution of direct currents, it is a matter of paramount importance, and destined to have a marked influence on future installations.

The officers of the company at the present time are: F. C. Phillips, president; E. V. Phillips, vice-president; Alex. E. Brown, secretary and treas-

M. D. Law, of Washington, D. C.

urer; and E. S. W. Moore, superintendent. Both Mr. F. C. Phillips and Mr. Moore have had a large and varied experience in every branch of electrical engineering abroad, and especially in England. Mr. E. V. Phillips has had an experience of 14 years among the electrical industries of this country. Mr. A. E. Brown is the inventor and manufacturer of the

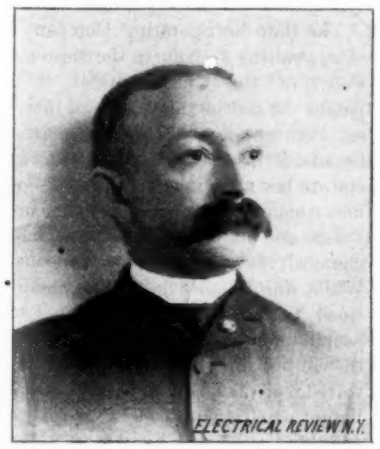
Henry Hine, Stanley Electric Mfg. Company, Pittsfield, Mass.

Chas. F. Brush.

well-known Brown hoisting and conveying machines that have revolutionized the handling in large quantities of ore, coal, pig iron and other

W. R. Brixey, of the Kerite Company, N. Y.

raw materials, and it is in the works of the latter company that the manufacturing of the heavy machinery and apparatus will be carried on. The company are about to establish agencies in New York, Chicago and Pittsburgh, and in this respect our



W. L. Candee, of the Okonite Company, New York.

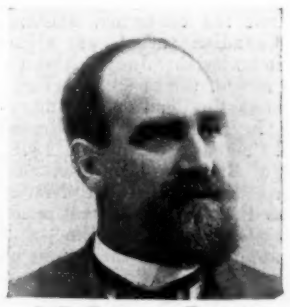
readers will be glad to learn that the New York department will be under the sole charge of Mr. W. A. Stadelman, so well-known to the electrical fraternity throughout the country through his long connection with the Niles Tool Works, and other companies. Thus briefly are presented the various establishments of interest to electrical men.

M. E. Baird, of Eddy Electric Mfg. Company.

Committees of both sexes have the

President Geo. A. McKinlock, of the Central Electric Company.

local arrangements in charge and the visiting electricians and their ladies will all receive a hospitable and kindly welcome.



C. R. Faben, of Toledo.

We are requested to call the attention of all delegates to the hour of opening the convention—10.30 A. M., Tuesday, in Army and Navy Hall.

The History of the Bate Refrigerator Case and the Probable Effects of the Decision.

To the Editor of Electrical Review:

The Bate Refrigerating Company's case, awaiting decision in the Supreme Court of the United States, is a patent contest of more general interest than any now before the courts, because it involves a construction of statute law affecting the interests of many manufacturers and dealers, corporate and individual, electrical, mechanical, chemical and miscellaneous. While this is quite generally understood to be so, comparatively few people know the history or merits of the contest, or what the question involved really is. United States Letters Patent No. 197,314 was issued to John J. Bate November 20, 1877, for improvements in processes for preserving meats during transportation and storage; it was assigned to the above-named company. The patentee states in his specification that the object of the invention is to prevent the discoloration of the surface of the meat and the taint to its external portions, which, by the methods heretofore adopted for preserving the same during transportation, frequently occurs. The improvement consisted in (1) enveloping the meats in a covering of fibrous or woven material, and (2) subjecting the same to the action of a continuous current of air of suitably low or regulated temperature. Neither step was new. Meats had long been covered to keep them from dirt or dust in transportation; and refrigerators had been used to subject them to the action of currents of chilled air, but it was claimed that a new and useful result was found to proceed from the combination: to wit, preserving the natural color of the meat during transportation, and thus having at the end of the trip a more merchantable article. The patent was sustained in the New Jersey circuit by Judge Nixon. On August 4, 1882, the case again came before the same Judge, the same defendant appearing by other counsel for the purpose of having the decree set aside. From the report of this case it appears that this same John J. Bate received Letters Patent of the Dominion of Canada, No. 6,938, dated January 9, 1877, paying the tax for a five-year term, the patent being delivered to the patentee June 18, 1878. The patent was for the same invention. The defendants claimed that this five-year patent was "previously patented," and, therefore, the American patent expired at the same time. The fact that Bate obtained a five-year renewal of his Canadian patent, or in other words, paid the tax for a second period of five years and thus insured the continued existence of the Canadian patent, was argued to be immaterial. Judge Nixon took this view of the case, following, as he believed, the decision of Judge Clifford in Henry vs. The Providence Tool Company, decided in 1878, and Judge Blatchford in Reissner vs. Sharp, in 1879; Judge Nixon also decided that he was "at a loss to understand what the time of filing the application for the patent has to do with the matter." It is to be noticed that Bate filed his application for his United States patent February 1, 1876, and that his Canadian patent was applied for and dated January 9, 1877. The Canadian patent has a possible term of 15 years, for which the patentee was permitted to pay a tax in advance at five-year intervals. Without specifically following the various decisions under the section of the Revised Statutes now awaiting construction, it is proper to say that the Supreme Court of the United States has subsequently dedided, in another case, that a prior granted foreign patent for the same invention only limits the life of a United States patent, so that it will expire at the termination of the potential term of such foreign patent, and that, whether or not the payment of the tax or any other necessary condition precedent has been complied with or not; that is to say, the Canadian patent of Bate had a potential term of 15 years, its effective life being dependent upon the condition that the taxes be paid. If the taxes were not paid, and the Canadian patent expired in five or ten years, nevertheless its limitation upon the life of a United States patent would be for a term of 15 years from the date of said Canadian patent. This decision of the Supreme Court was in the case of Bate vs. Hammond, which presented two questions, the first of which they did not see fit to decide. It was this very question of the effect of the date of application; the second question was the one decided as last above stated. Practitioners and the public were, and have been, duly thankful, however, as this decision rendered this point fairly certain and saved many patents which otherwise would have been destroyed. The Supreme Court has never decided exactly when an invention was "previously patented" in a foreign country. That question is to be answered in the present Bate case; the Court cannot possibly avoid answering it now, for it is the *only question presented for decision.*

The Supreme Court has now adjourned until March; it is not improbable that the delay may indicate a division in the Court, and a dissenting opinion. I do not think the opinion of anyone, layman or lawyer, as to the probable character of the decision to be rendered is of any value, and no one has expressed an opinion so far as I can learn. I think the vested interests on the two sides, respectively, are about equal; whichever way the decision goes, satisfaction and dissatisfaction will be about equally distributed. It will undoubtedly be a good thing for patented property interests to have the question finally determined.

The early inventions of Mr. Edison in the telegraph, the telephone, the phonograph, electric lighting, and the electric railway, those made and forming the subject matter of patent applications prior to 1882, were patented upon a construction of the Statute the reverse of that which was subsequently held by Judge Nixon and the Circuit Courts of the United States; almost all applications were made upon the theory that if you first apply for your American patent, then apply for and issue your foreign patent, the life of the American patent will not be limited thereby. If the Supreme Court takes this view of the case and reverses the Circuit Courts all patents which were not issued in the United States 17 years ago and for which no foreign application was made prior to the date of the American application will be found to be possessed of a more or less extensive term of existence.

W. B. Vansize.

New York, Feb. 12, 1895.

The contract for the electric light plant at Allegheny City, Pa., was finally awarded to the Western Electric Company after a bitter contest.

ON EXPERIMENTS WITH TESLA CURRENTS.

BY F. HIMSTEDT IN "WIEDEMANN'S ANNALEN."

The author has succeeded in reproducing most of Tesla's experiments with very simple apparatus. He utilized at first the Lecher method of producing electrical oscillation, but later on used the still more common Leyden jar. The pole of a powerful Rubenkorff coil, 50 centimeters long and 20 centimeters in diameter, and used with five or six accumulator cells, was connected to the inner coatings of two medium-sized Leyden jars insulated from one another by standing on paraffine blocks, and also to a spark micrometer. The outer coatings of the jars were connected together by a copper wire four millimeters thick and 120 centimeters long, bent into U shape. A 16-volt glow lamp put in parallel with this wire was soon brought to incandescence when the spark micrometer was suitably adjusted. When jars 16 centimeters in diameter and 42 centimeters high were used, as many as three lamps could be made to glow—a 65-volt lamp below, a 16-volt lamp in the middle and a 2-volt lamp at the top. If the nipple of such a lamp be filed off it ceases almost entirely to glow. Tesla ascribes this fact to the alteration in the molecular bombardment in the lamp; but the author considers that it is due to the connection of heat by the air admitted.

If the incandescent body be a platinum of 0.05 to 0.1 millimeter diameter, it oscillates violently while glowing, not in one plane like a string under tension, but in every possible plane, becoming a model of a beam of natural light. It is essential to the success of this experiment to use a proper interruptor and a suitable spark micrometer. As interruptor the author used the Foucault form, with tough zinc amalgam in the place of mercury, and covered with machine oil. The balls of the micrometer are best made of zinc.

The Tesla transformer was made as follows: A glass tube of four centimeters diameter was taken, and on it were wound 10 turns, one centimeter apart, of a wire four millimeters thick. Over this was pushed an ebonite tube, six millimeters thick, on which were 200 turns of wire one millimeter thick and spaced with one millimeter between each. The whole transformer was placed in an earthenware container filled with machine oil, the secondary terminals being two metal balls on ebonite pillars. The primary was put in the place of the U-shaped wire, between the outsides of the Leyden jars. When the interruptor begins working, brush discharges start from these balls, and sparks spring to a conductor put near. Two parallel wires starting from the balls have between them a broad band of light three to four meters long. If one pole be put to earth, and to the other be connected a wire 15 to 20 centimeters long, hanging freely downwards, it begins to move when the interruptor is started and describes the surface of a cone, which is easily seen in a dark room by the brush discharge, which renders it luminous.

If anyone takes hold of the pole of such a transformer with the hand, rays of light start from any part of his body when a conductor is held near. If he stands on a metal plate he feels a pricking sensation in his feet, and in the dark the rays coming out of the soles of his shoes may easily be seen. If several persons form a chain, and the first touches one pole of the transformer, while the last holds in his hand a vacuum tube with or without electrodes, the tube glows brilliantly. None of the persons feel any symptom of the electrical phenomena.

If one pole of the transformer be earthed and the other connected to a metal sphere 60 centimeters in diameter, vacuum tubes glow brightly up to 15 feet away. A glow lamp connected to the unearthed pole glows faintly in a phosphorescent manner; but if a large metal reflector be placed over the lamp it glows brilliantly, while the filament oscillates so violently that it soon breaks. If a conductor be held near the point of the lamp, the glass is immediately punctured by the current, a continuous and brilliant stream of sparks passes through the opening, and the filament glows until it burns away.

In the second portion of the article the author remarks that a Tesla transformer differs in important particulars from an ordinary Ruhmkorff coil. A vacuum tube connected in any manner to the transformer shows kathode light at both electrodes, and evenly distributed anode light in the center. An alteration of direction of the primary current, or alteration of pole, has no effect in altering this phenomenon. An electroscope is always charged positively if held to either pole, and both poles give positive Lichtenberg figures only. It was found that this effect depended on the nature of the surrounding medium. Air and oxygen produce positive discharge; hydrogen, illuminating gas, nitrogen, carbon dioxide and ammonia give negative discharges. If a pole have two points immersed in air and hydrogen, respectively, positive and negative discharges take place simultaneously, according to the medium. If a pole be in oxygen, and nitrogen be gradually added, an electroscope shows first a positive charge, first increasing, reaching a maximum at the mixture corresponding to air, and then diminishing, and ultimately becoming negative. With a Ruhmkorff coil the charge in the electroscope changes sign if the primary current be reversed.

The Detroit, Mich., Electric Light and Power Company has re-elected its old board of directors, who have chosen these officers for 1895: F. F. Palms, president; George M. Vail, vice-president; William S. Crane, treasurer; William H. Fitzgerald, secretary and manager.

The Carbonnelle Microphone for Long Distance Telephony.

At present, says our contemporary, *L'Industrie Electrique*, there are no microphones which can be used over long distance lines without specially constructed induction coils. This difficulty, inherent in all ordinary microphone instruments, was first noticed and overcome by Edison. (This is an historical error of old standing—Mr. E. Berliner originated the use of the induction coil with microphones.)

Although such a system worked, indeed, admirably over short lines, it failed when applied to commercial work over long distances. While it is true that our American friends, by the use of their powerful and carefully constructed microphones, together with special induction coils, are able to talk from Boston to Chicago, it should be borne in mind that the success is largely due to the use of an extra heavy line conductor; in other words, it required the investment of an additional large capital—a useless expense, according to our view of the matter. It is evident that the increased size of the line conductor is and cannot be the proper solution of the problem. Indeed, by laying a cable of enormous size we would be able even to talk across the Atlantic.

A much better way of accomplishing long distance telephony, and a much more rational solution of the problem, offers the use of what is known as the Carbonnelle system.

It is based upon the use of a new high resistance contact microphone; in fact, the apparatus with which the experiments have been conducted at Paris measured 1,000 ohms resistance when at rest. As soon as the membrane vibrates under sound impulses, the initial resistance increases rapidly and reaches 6,000 up to 8,000 ohms. Of course, such a microphone has no use for an induction coil to overcome the resistance of the various circuits over which conversation is required.

A Carbonnelle transmitter works best with three Leclanches. Assuming, then, that three batteries are required for the satisfactory operation of one transmitter, and that the exchange has 3,000 subscribers, we shall have one pair of flexible connectors for every five subscribers; or 600 pairs for the 3,000 subscribers; *i. e.*, we shall need 1,800 batteries or their equivalent at the central station.

Again, as it is customary in France to furnish each subscriber with six cells, 3,000 subscribers require 18,000 cells, or 10 times the number needed for the Carbonnelle system employing centralized batteries.

Although the actual decrease in the number of batteries constitutes an important factor of saving in the operating expenses of a telephone central, another great advantage of this system consists in the comparatively small current output needed for the operation of a large exchange. A practical illustration corroborates the correctness of this assertion.

Assuming that the total line resistance of two city subscribers connected for conversation is 2,500 ohms, comprising

Two microphones, each 1,000 ohms	2,000 ohms.
Two receivers, each 150 ohms	300 "
Average line resistance	125 "
Magnetoes	75 "
Total	2,500 ohms.

and that the potential of the battery is 5 volts, corresponding to the voltage of four Leclanches; then

$$C = \frac{5}{2{,}500} = 0.002 \text{ A.}$$

The actual output of energy would be

$$5 \times 0.002 = 0.01 \text{ Watt.}$$

Applying the same computation to an exchange system employing transmitters with induction coils, we have seen that the resistance of the primary circuit, including the microphone, inductorium and battery, as a rule does not exceed 25 ohms. If the transmitter works with one Leclanche, we have

$$C = \frac{1.25}{25} = 0.05 \text{ A, or}$$

$$1.25 \times 0.05 = 0.0625 \text{ Watt.}$$

And if the same transmitter requires three cells,

$$C = \frac{3.75}{25} = 0.15 \text{ A,}$$

$$0.15 \times 3.75 = 0.5625 \text{ Watt.}$$

Now, as such system necessitates two induction coils, one at the transmitting, the other at the receiving station, we have

Two subscribers using ind. coils, 1 cell each	0.125 W.
As against Carbonnelle system.	0.01 W.
Two subscribers using 3 cells	1.125 W.

In other words, from 12.5 to 112 times as much electrical energy is needed for telephone systems employing induction coils than is required for the Carbonnelle system.

The saving in operating expenses is increased by the use of metallic circuits. Here two mains suffice to supply the energizing current between which all the connecting cords of the switchboard may be bridged. Furthermore, if the central battery has to furnish but 600 times .002 A., or 1.2 A under a tension of 5 volts.

Unless the lines are very long, interurban and international conversations should be carried on by the battery which is used for the exchange work proper. It is useful and advisable to increase the battery, as the resistance of the long lines greatly exceeds that of the average interurban line. As a rule, it will suffice to add one volt to every 500 ohms resistance.

In practice such increase of current offers no difficulty whatsoever, because in all exchanges long distance service is performed at a special switchboard, and taking advantage of this circumstance we insert 1, 2, 3 *n* additional elements in the connecting cords of that board according to the length of the various long distance lines. In Belgium it has been ascertained that for all practical purposes the Carbonnelle microphone works satisfactorily over the long interurban lines with five cells Leclanche, and then its efficiency was superior to the best work achieved with granular carbon transmitters. In short, five cells are amply sufficient for interurban transmission.

The Brussels Exchange employs grounded circuits and multiple boards, each section serving 200 subscribers. Consequently each section requires 40 pairs of connecting cords, 32 of which being provided for the urban and eight for the interurban service. With the Carbonnelle system only three elements may be inserted into each of these 32 pairs, and five into the remaining eight, or a total of 136 batteries, a saving of 32 cells in 100.

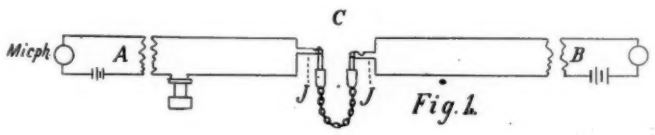
LONG DISTANCE TRANSMISSION.

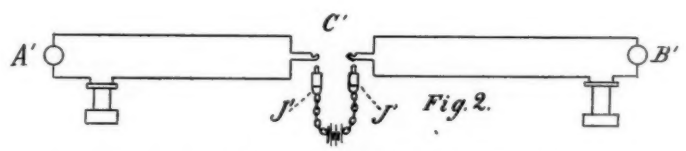
In order to compare the two systems, we will draw two simple sketches. Fig. 1 represents two subscribers using induction coils A and B; the central is indicated at C, and jacks by J and J.

Fig. 2 represents two subscribers' station. A′B′C′ is the central and *j′* J′ the connecting cords which contain the energizing battery.

Referring first to Fig. 1, the current in the primaries varies from one to 15 ohms. Such microphones have a maximum efficiency with a given number of cells, say, from one to three Leclanches. If we increase the battery—the resistance of the circuit remaining constant—the microphone is soon overheated, burns, and is finally useless.

On the other hand, the resistance of the secondary circuit is subject to variations, depending upon the length of the connected lines. When at rest, no current passes through the secondary circuit. Now, as the feeble intensity of the secondary current must energize the entire line, it is evident that the resistance and capacity of the compound circuit greatly influences the efficiency of electrical transmission; in fact, the subscriber at B will hear less and less in proportion to the intervening line, and at a given point transmission is impossible.





THE CARBONNELLE MICROPHONE FOR LONG DISTANCE TELEPHONY.

Very different conditions obtain in the Carbonnelle centralized or common battery system. Here the receiver reacts on microphone variations ranging from 1,000 to 8,000 ohms, and the intensity of the current at A′ B′ is in direct proportion to the electro-motive force of the battery, and in inverse ratio to the line resistance, so that when the limit of transmission has been found with a given line and battery all that need be done is to increase the electrical energy at the sending station.

In fact, the limits of long distance transmission given by Mr. Preece do not apply at all to this system of telephony, a fact which has been abundantly proved by experiments made at Paris over an artificial line whose product (ohms microfarads) far exceeded 100,000.

With the ordinary telephone system no sound could be transmitted through this line, while a Carbonnelle transmitter, without an induction coil, gave excellent results with six Leclanches.

Area Lighted by a Sixteen Candle-Power Lamp—Thanks to Correspondents.

TO THE EDITOR OF ELECTRICAL REVIEW:

Your copy of February 6 duly received. I wish to express my sincere thanks to both Mr. Forée Bain and Mr. D. L. Davis for their prompt answers to my question. I also am grateful to you for the interest you took in the matter.

Yours respectfully,
L. E. LANNAN.

Lehigh University, Feb. 10, 1895.

VIEWS, NEWS AND INTERVIEWS.

Electric ferryboats will in all probability be started in the Spring between Skarpsno, Christiania, and Bygdö. Two parties had applied to the Christiania-Sweden Corporation for the concession, but the corporation replied that no concession could be given, or was necessary, for the traffic in question.

An electrical supply firm at Halifax, Nova Scotia, recently received the following letter from an anxious inquirer in Cape Breton:

"Will you kindly let me know all particulars about the incandescent lamps which you have advertised in the *Recorder*? That is, what is used in them; is it kerosene oil, etc., or if not, what it is? And can the material be easily obtained? Also let me know if the light from your lamps is much superior to the ordinary kerosene ones. I am desirous of getting one or more of them and would like to know all about them."

A case of electricity generated by a plate of false teeth occurred recently in England. A man feeling a severe pain in his tongue consulted a doctor and a dentist, neither of whom could find anything wrong. He then went to an electrician, who found that his false teeth were fastened to the composition plate with two metals; they were connected by wires to a galvanometer, which, as soon as the metals were moistened by the saliva, showed a current strong enough to cause ulceration and severe pain. The plate was covered with an insulating varnish, which put an end to the trouble.

In his newly published work, "Corea," Mr. Henry Savage Landor tells a tale of the telephone. Some months before he arrived in Seoul a foreigner had visited the king, soliciting orders for installations of telephones. The king, being much astounded and pleased at the wonderful invention, immediately, at great expense, set about connecting by telephone the tomb of the queen dowager with the royal palace. Many hours a day were afterward spent by his majesty and his suite in listening at their end of the telephone, and a watchman was kept all night in case the queen dowager should wake up from her eternal sleep. But not a message, or a sound, or a murmur, even, was heard. The king was disgusted, and the telephone was condemned as a fraud by the majesty of Cho-sen.

A "Jackassable" Trail.

Up to last night the survey trail for the electrical power enterprise has been extended 2,300 feet into the canyon on the north side of the river. It is from four to eight feet in width and is open for the use of the public, provided the workmen be not interfered with. It is not wide enough for vehicles, of course, but is, so to speak, pedable, jackassable and equusable—or in other words, pedestrians and equestrians can readily traverse it.—*The Daily Californian, Bakersfield, Cal.*

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PRIMARY BATTERY TESTING.

On another page of this issue we publish an interesting and valuable article on the method and apparatus which the electricians of the German telegraph department employ for testing the commercial efficiency of batteries. Briefly, that method consists in a modification of Professor Kohlrausch's familiar and classical test by means of alternating currents and the telephone. Based on this principle, there has been evolved a testing device which, under certain conditions, becomes a direct reading ohmmeter, by means of which commercial tests of the efficiency of primary batteries can be executed with a considerable degree of precision and in rapid succession.

We believe that this apparatus should be capable of being put to good use by American manufacturers and users of primary cells for quick and efficient commercial tests. We would, however, emphasize two points in connection with the use of the Kohlrausch bridge method:

First. The necessity of employing a circuit-breaker giving a constant range of vibrations; for if the periodicity of the bridge current is allowed to vary, due to faulty construction of the interrupter, consistent results cannot be produced by this method on account of self-induction, which gives a different apparent resistance for minimum sound in the telephone for every variation in the adjustment of the circuit-breaker.

Secondly. The periodicity of ammeters, mentioned by Mr. Strecker, is an unknown quantity in American measuring instruments, their standard being too high to allow of the use by any commercial laboratory of instruments which are not strictly "dead beat."

ADDRESS BY MR. BRUSH.

A highly interesting feature of the electric light convention this week will be an impromptu address by Mr. Charles F. Brush. It will be entitled "Some Early Recollections of Arc Lighting" and will be presented in a conversational way by Mr. Brush early in the proceedings. It was only at the last moment that Mr. Brush saw his way clear to consent to this and we are sure every member of the association will be delighted to hear him.

LUCKY THIRTEEN.

The ELECTRICAL REVIEW, published at 13 Park Row, New York, was 13 years old last week, February 13. Here's a trio of thirteens that's sure to continue good luck for the ELECTRICAL REVIEW.

THE N. E. L. A. AND THE ATLANTA EXPOSITION.

We hope to see the National Electric Light Association, at its convention in Cleveland this week, take a strong position in favor of the Cotton States and International Exposition, to be held at Atlanta this Fall. A magnificent building is being specially erected for electrical exhibits. The Exposition is in most capable and progressive hands, and has received the endorsement of Congress, a large appropriation having been made for an exhibit by the United States. Resolutions endorsing the Exposition and urging a comprehensive exhibit of electrical machinery should be introduced and promptly passed by the National Electric Light Association before it adjourns.

The Cleveland meeting promises to be one of the most successful in the history of the National Electric Light Association.

Electric light men, in your deliberations, don't forget that a magnificent place to hold your conventions is the Grand Central Palace, New York city.

It requires two and one-half pages of the Century Dictionary to define the word "light." No wonder the electric lighting industry contains such a number of brainy men!

A Cincinnati man was fined $5 in a police court because he refused to pay his fare in a street car that wasn't heated. If the man had his ride his fare was due, heat or no heat. He could have gotten off the car when he found it wasn't heated. But this is no excuse for cold cars.

The ELECTRICAL REVIEW, in common with the entire civilized world, rejoices over the safe arrival of "La Gascogne." It was this staunch French ship that carried so many electrical visitors to Paris during the great exposition of 1889, and all felt much interest in her recent retarded yet finally successful voyage. A broken piston and heavy storms caused the delay of nine days.

The concluding words of President Morrison, at the close of the first convention of the National Electric Light Association at Chicago in 1885, are as pertinent to-day as they were on that occasion. Here they are:

"You have started an association here which will enable you to stand shoulder to shoulder to defend your rights. It will give you facilities for knowing what your rights are that you never had before. Watch the working details of your business, hold to strict account your engineer and superintendent, that they may furnish you with every change, however unimportant, that takes place in these details, and furnish the same to this association. Then every man will come to the convention with brain teeming with subjects of interest to his brother members."

Wall Street and the Electrical Stock Market.

General Electric suffered another week of depression at the hands of professional bear operators. It rallied only fractionally from the low price of last week, the range being between 28¼ to 29¼. The debenture bonds showed some weakness, declining on limited sales from 89½ to 88⅝.

There was no material change in the price of Westinghouse securities. The company advertises to pay interest on its scrip payable March 1. The books close February 23 and reopen March 4. The company's new shops at Pittsburgh have been completed.

Edison Electric Illuminating declined two points on the forced sale of small lots of stock.

The International Bell Telephone, of New York city, has reduced its capital from $1,700,000 to $1,000,000.

The Interior Conduit and Insulation Company, of New York, has filed with the secretary of state a certificate for an increase in the capital stock from $1,250,000 to $1,575,000. The stock has been very quiet for months up to a recent date when it has shown some little activity at an advance. It sold Friday at 38¼, which is an advance of about 2 points.

On the Boston exchange Bell Telephone was held from 193 to 190½. General Electric preferred was quiet at 61. New England Telephone showed no change; the quotation is 68. Fort Wayne Electric was bid 1 and held at 1½. BAIN.

New York, February 16.

Electric Construction and Supply Company Embarrassed.

A deputy sheriff closed the offices of the Electric Construction and Supply Company at 18 Cortlandt street, New York city, last Friday, on attachments for $11,000 obtained by creditors. The company manufactured the well-known "Ward" and other arc lamps. The liabilities are reported to be about $80,000. The company is capitalized for $225,000 under the New Jersey laws. Its officers have many friends in the electrical field and it is hoped that the embarrassment is only temporary.

Report of the N. E. L. A. Convention at Washington.

The report of the seventeenth convention of the National Electric Light Association, held at Washington, D. C., February 27 and 28 and March 1 and 2, 1894, was issued by Secretary George F. Porter last Saturday. The volume is uniform in size and binding with previous reports, and is from the press of the James Kempster Printing Company, New York. A feature of this report is the excellent half-tone engravings of photographs taken by electric light at the World's Fair, which accompanied the lecture delivered on that subject at the Washington meeting.

The scheme for an electric railway between Pittsburgh and Greensburg, Pa., has been abandoned.

New Telephone Company in Philadelphia.

The Councils' Electrical Committee at a meeting February 7, 1895, reported favorably on ordinances granting privileges to the Drawbaugh Telephone and Telegraph Company and the Central Telephone Company. The ordinances had been amended and made identical at a previous meeting, and with the exception of reducing the bond from $500,000 to $100,000, the committee made no further changes in their provisions.

National Conduit Manufacturing Company.

Mr. J. P. McQuaide, secretary and treasurer of the National Conduit Manufacturing Company, *Times* building, New York city, will represent his company at the Cleveland electric light convention, and will be glad to welcome anyone interested in underground work at his headquarters in the Hollenden Hotel. The cement-lined iron conduits made by the National company have achieved an enviable popularity and are in service in all the principal cities of this country. Mr. H. F. Tate, of Chicago, is the company's western manager.

A New Telephone Transmitter.

The "National" granular carbon transmitter, patented December 11, 1894, is said to have been thoroughly tested and found to be fully equal to the little National receiver. This transmitter is in use by the government and many large railroad corporations, who pronounce it the most powerful instrument that they have ever tested.

What makes this transmitter so desirable is the fact that it can be used either with one or six cells of battery, according to the distance or length of line to be talked over, and the manufacturer claims it represents to-day the highest state of the art in telephony. This instrument is neither a microphone nor a "Blake" transmitter, but a production of the National Telephone Manufacturing Company, of Boston.

A Progressive Lamp Company of Cleveland.

The growth and progress of the Buckeye Electric Company, of Cleveland, during the past year has been remarkable in spite of the dull times. New and substantial brick buildings have been added to the plant, and new equipment of boilers, engines, pumps, both mechanical and electrical, have also been installed. The working capacity is now about 6,000 finished lamps per day, and we are reliably informed that the company finds no difficulty in marketing its entire output, but on the contrary has been largely behind its current orders throughout the entire Winter season.

The Buckeye company is backed by some of the most substantial business men of Cleveland and has always had ample capital at its disposal.

The management has been active and successful, and the users of the Buckeye lamp, who are very numerous and scattered throughout the entire country, will not admit that any other lamp is its equal.

ELECTRIC RAILWAY NOTES.

Officers of electric railway companies are requested to send promptly to the ELECTRICAL REVIEW *notices of meetings, election of officers, declarations of dividends, financial reports and all items of interest in connection with the financial and practical operation of their roads.*

About $62,000 has been paid into the Philadelphia city treasury for street car licenses for 1895.

The Provo River will be dammed at a point near Heber City, Utah., for electric power purposes.

Engineer Norman McD. Crawford has been made general manager of the Hartford, Conn., Street Railway Company.

S. P. Maury has bought the cross-town street railway at San Antonio, Texas, for $2,000. The property was in the hands of a receiver.

The Keokuk, Iowa, Electric Railway suspended operations on February 7 for an indefinite period on account of lack of patronage.

Stephen K. Webster has sued the Electric Traction Company, of Philadelphia, for $100,000 damages for injuries caused by a trolley car collision.

Hon. A. F. Gerald announces that the material is all contracted for and the new electric road from Bangor to Oldtown, Me., will be completed before August 1.

Baltimore street cars are now supplied with safety fenders. The press of that city isn't satisfied yet—an interchangeable transfer system is the topic at present.

The Columbus, Ohio, Street Railway Company is experimenting with an electric headlight, which will be used on all cars if it proves as useful as it is hoped it will.

The Massachusetts Street Railway Association has petitioned the legislature that electric railways may be permitted to carry United States mail, to have police and to haul freight, merchandise and express packages.

The car house of the Newton and Boston Street Railway Company, at Newtonville, Mass., was completely destroyed by fire on February 13, together with 11 cars and a large quantity of electrical equipment. Loss, $30,000; insured.

A number of Detroiters, headed by Capt. W. H. Stevens, are interested in a project to utilize Glen Falls, Ontonagon County, Mich., in developing electric power with which to operate a number of abandoned copper mines in that neighborhood.

By the sale of the Coraopolis and Neville Island Street Railway to the interest controlling the West End and Second Avenue Traction Company, that system completes its chain from Coraopolis to McKeesport, Pa., the longest distance across the Greater Pittsburgh.

The South Bethlehem, Pa., Town Council has decided at once to sue the Lehigh Valley Traction Company for the recovery of the tax on poles, cars and wires of the company, and its leased lines, which, under contract, it is required to pay. The amount is nearly $500.

At a recent meeting of the directors of the Brooklyn Heights, N. Y., Railroad Company and of the Long Island Traction Company Daniel F. Lewis was chosen president, John G. Jenkins vice-president in place of E. W. Bliss, and W. A. H. Bogardus secretary and treasurer of both companies.

A franchise has been granted by the Board of Trustees of White Plains, N. Y., to the New York, Elmsford and White Plains Railroad for the operation of a trolley road through Railroad and Central avenues. The company will forfeit $2,500 if the road is not in operation by August 1.

The owners of timber lands at Lac des Quinze on the Upper Ottawa, Canada, are about to build an electric railway on the banks of that river from Lake Temiscamingue to Lac des Quinze, which empties into the Temiscamingue and receives its name from the 15 rapids between it and the first named body of water, these rendering it unfit for navigation. The railway would overcome this barrier and the power for furnishing the electricity could easily be taken from the falls. The railway would be of considerable length.

Col. N. H. Heft, president of the Bridgeport, Conn., Traction Company, is to have complete supervision of the installation of electricity on the Nantasket Beach division of the N. Y., N. H. & H. Railroad. He is at the head of the company's electric department. President Clark and Colonel Heft have decided on the location of the power station, one mile from the Old Colony house station, on the Nantasket division. Regular coaches will be used, hauled by baggage cars equipped with motors. If successful, electric locomotives will be substituted later. It is expected that Colonel Heft will resign the presidency of the traction company soon.

The consolidation of all the street railways of St. Louis, Mo., under one management is being carefully planned and worked out. Bills are being introduced at Jefferson City which will remove the hindrances that have hitherto stood in the way of the unification. One of these permits corporations to capitalize up to $50,000,000, instead of $10,000,000, as now; a second allows corporations to use the stock of any other concern with which they may consolidate; while a third repeals all provisions now preventing the consolidating of private corporations. The corporation which is to include all the street railroads will, it is said, be entitled the St. Louis Traction Company, and will probably be capitalized at $20,000,000.

TELEPHONE NEWS AND COMMENT.

Mr. W. D. Sargent, of Brooklyn, N. Y., general manager of the New York and New Jersey Telephone Company, returned last week from a six weeks' trip to Florida much improved in health.

The American Telephone and Telegraph Company is rebuilding some 40 of its long distance lines in Massachusetts, which were damaged by storms several months ago. A larger number of shorter poles are being used to replace the tall ones.

When Casimir-Périer resigned the presidency, France might have had the novelty of a revolution by telephone. The Duke of Orléans, who was in readiness at Dover, is said to have hired the exclusive use of the telephone between England and Paris for 24 hours.

It has recently been asserted that the first idea of exchange work known in history is found in F. M. A. Dumont's British patent of February 7, 1851. This describes an exchange system of dial telegraph instruments, connected by short lines with branch central stations, which were provided with trunk lines connecting them with a principal station.

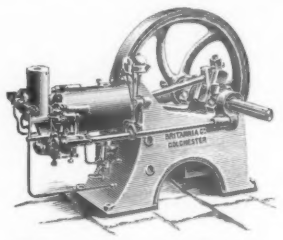
Mr. H. H. Eldred has retired from the presidency of the Columbia Telephone Manufacturing Company, of New York city, General Wallace assuming that position. The Columbia company controls several important patents relating to telephone switchboards and apparatus, and will undoubtedly soon be heard from energetically in the field of practical operation.

The investigation by a committee of Philadelphia councilmen into the affairs of the Mutual Automatic Telephone Company was continued on February 13. Messrs. Porter and Martin were the principal witnesses of the day. When the stock registry of the company was recently placed in evidence it was shown that 1,525 shares each were recorded in the names of Martin and Porter, and it was to explain this evident ownership that the men were called. Both stated that the company placed their names on its stock book without authority. Martin said he had never seen nor held any of the stock.

Mr. C. Thomson, proprietor of a large nursery near Rapid City, S. D., has a barbed wire fence telephone line in successful operation. The line is a little over five miles long and the fence, which is used for the transmission line, has been standing for 12 years. The wire is fastened to the posts with ordinary staples. "There are no glass balls used," writes Mr. Thomson. "I consider them of no use—they may be ornamental." About April 1, 1893, Mr. Thomson contracted with the Nebraska Telephone Company to extend one of its Rapid City lines about a mile, so as to connect with his barbed wire fence. Where the line had to pass gates and cross the roads poles 12 feet high were erected to carry the line across. The line crosses the road four times and passes over five gates. Mr. Thomson, by means of his barbed wire fence telephone, has communication with all the lines in the Black Hills, "and there is no better line and few as good in the Hills."

The annual report of the Erie Telegraph and Telephone Company for the year ending December 31, 1894, shows: Sub-companies — Gross income, $1,033,619.22; gross expenses (including dividends paid), $990,-857.75; surplus, $42,761.47. Proportion of dividends received by the Erie Telegraph and Telephone Company, $240,667.50; dividends paid (four, $48,000 each), $192,000; balance, $48,667.50; expense and interest account, $25,755.82; net surplus, $22,911.68; surplus of sub-companies, $42,761.47; total surplus, $65,673.15. Subscribers—Number connected December 31, 1893, 15,413; added during the year, 761; total December 31, 1894, 16,174. The statement of assets and liabilities follows: Assets—Stocks and bonds, $5,612,479.58; treasury stock, $200,000; accounts receivable, $62,593.99; cash, $6,950; total, $5,882,023.57. Liabilities—Capital stock, $5,000,000; bonds and notes issued, $674,500; reserved for dividend No. 45, $48,000; surplus, $159,523.57; total, $5,882,023.57.

The annual statement of the Southern New England Telephone Company shows: Assets—Franchise,



THE BRITANNIA OIL ENGINE.

$175,000; construction, $1,959,747.84; supply department, $62,671.16; real estate, $128,691.68; stock and bonds, $302.50; sundry reserve, $6,533.96; accounts receivable, $50,376.20; cash, $12,474.55; total, $2,395,797.89. Liabilities—Capital stock, $1,500,000; debt, $831,173.71; reserve, $12,472.56; surplus, $52,151.62; total, $2,395,-797.89. The business of the year 1894 is seen from the following statement: Earnings—Exchange service, $375,116.28; toll service, $80,243.12; private line, $6,256.57; metallic circuit loop, $3,712.32; real estate, $7,489.80; miscellaneous, $1,375.16; total, $474,472.25. Expenses—General expense, $60,050.13; operating, $88,250.65; maintenance, $119,424.34; rental and royalty, $69,655.96; real estate, $906.75; interest, $39,874.75; dividends paid, $74,970; total, $452,142.62; net gain or surplus, $22,319.63. The company has a total of 5,536 stations, 5,144 subscribers, of which 4,838 are on metallic circuits, and 257 toll stations.

A Curious Lightning Phenomenon.

Mr. P. V. Luke, of Calcutta, India, director of the construction branch, Indian Government Telegraphs, has sent the following communication to the secretary of the Institution of Electrical Engineers (British):

The following case of lightning happened on the telegraph line be-

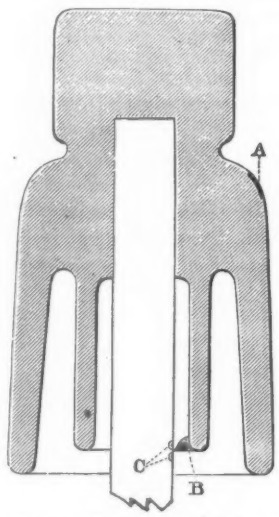


DIAGRAM OF INSULATOR STRUCK BY LIGHTNING.

tween Bombay and Bhusaval in October, 1894. One of the iron wires was broken, and the cause put down to lightning. As no insulators were smashed, the local superintendent, Mr. Kenyon, called for the ends of the wire, and had two of the white porcelain insulators on each side of the break removed for examination. Of the four insulators, one was cracked and the stalk loose. The other three appeared to be entirely undamaged, except that each had a little brown mark at the edge of the inner cup, in the position marked B in accompanying sketch; and on each stalk, at C, just opposite, was a small mark about the size of a pin's head, with a little conical point in the center, where the flash had apparently sparked across. There was also a brown mark at A where the wire

THE "RETIRING HOOK" TELEPHONE.

binder touched the insulator. At each brown mark the glaze of the porcelain was destroyed, being reduced to a powder which disappeared in water. The three apparently undamaged insulators were tested after being immersed in water for 24 hours, and each gave an insulation resistance of over 5,000 megohms. If the lightning went through the porcelain it would assuredly have destroyed the insulation; failing this, it must have passed over the whole surface of the porcelain to get from the line wire to the edge of the inner cup—which seems curious.

The Britannia Oil Engine.

Thr accompanying illustration shows the Britannia oil engine, made by the Britannia Company, of Colchester, England. It is claimed to be the most perfect oil engine yet invented, as it has perfect combustion, a clean exhaust, no deposit and no danger. The makers say that the saving in cost of a 10 horse-power engine, as compared with a steam engine, will be about $350 per year, with other sizes in proportion.

Some of the advantages claimed for this engine are that no working parts are hidden in the base, the engine is easily started in from eight to 12 minutes, the cheapest paraffine or petroleum oil is used, there is little odor and there are fewer valves and working parts than any other engine, thus permitting the use of unskilled help.

It is claimed that the Britannia engine will run from six to eight months without cleaning, and that the cost per brake horse-power is less than one cent per hour. The engine is designed especially for electric light and power installations.

The "Retiring Hook" Telephone.

Gent & Company, of Leicester, England, are the manufacturers of the telephone illustrated herewith, which is described in our London namesake. The "retiring hook" system is designed to simplify and cheapen the means of intercommunication in places where an interior telephone system is desirable.

The name is derived from the method adopted to avoid the frequent annoyance caused in other "direct call" systems, by the switches being left as last used, either through carelessness, or by the springs that should return them failing to act and thus preventing another call from being made. In these instruments the receiver hook disappears into the instruments as soon as the switch is moved and the receiver taken off, and the operator cannot, therefore, hang up the receiver again until the switch is put "home."

Deadly Illuminating Gas.

The people of Hartford, Conn., had a dangerous experience with gas during the night of February 6. There was something wrong at the gas plant, and about 10 o'clock P. M. the gas was shut off at the plant. Soon after it was turned on again full head. Naturally, in sleeping-rooms and stores where gas is left burning all night, shutting off the main supply put out the lights, and when the supply was turned on again the deadly fumes poured out. The prompt work of the police in notifying householders and others alone prevented the asphyxiation of many persons and probably explosions and fires. As it was, there were many narrow escapes.

HINTS UPON DAILY WORK ABOUT A DYNAMO PLANT.

ABSTRACT OF A PAPER READ BEFORE THE NORTHWESTERN ELECTRICAL ASSOCIATION, MILWAUKEE, JANUARY 16, 1895, BY PLINY NORCROSS.

(*Concluded from page 79.*)

In placing wall controllers, I would suggest that it is well to have them so placed that they cannot tremble. If your building is of wooden frame, I would place a post through the floor and well into the ground, so that it will not be affected by the vibration of the building. Then fasten to the upper end of the post a plank crosswise, like a guide board, and on this plank secure the wall controller, and you will be surprised at the improvement.

I like the plain carbon better than the coated, for the reason that the copper coating melts into little globules and flies off to the globes and breaks them. I think the plain carbon gives a better light. I prefer a carbon with a blunt round end or even a flat end. By this plan the carbons are not so likely to slip by each other during the time between setting them and lighting. Our customers desire longer hours. One way of effecting this result is the use of a larger carbon.

Wiring through trees is unpleasant work and when the wire is once threaded through a tree the insulation is slowly rubbed off, and then current is wasted and the dynamos flash. A couple of pieces of thin, narrow boards from 18 inches to two feet long, grooved so as to receive the wire and then fastened together with the wire under the offending limb is a good device for such trouble. Of course it should be put on before the insulation is worn off.

I really believe that defective wiring and poorly made joints cause an immense outlay of current. Let your whole line be looked over often and you will find that your coal bill has some other cause for its size than furnishing light to your customers.

As to prices. The laborer is worthy of his hire. The man who has been rash enough to invest his savings, or credit at the bank, in a good electric light and power plant is a public benefactor and should receive a fair interest on his investment and a fair return for his labor. Ten years ago the gas companies of the world looked with some apprehension upon the new light. It was to them what the star in the East was to Herod, a signal of a coming overthrow. But these fears were, in a large respect, groundless. I am sure that more gas is used to-day than ever before. The price has been reduced. All sorts of devices have been adopted to enable the gas companies to keep their stock at or above par, and they have succeeded even beyond their own expectations.

Gas has several very strong points in its favor. It can be made of water and gasoline and a little coal, and when thus cheaply made it can be stored away in tight receivers until wanted. If we don't use it one day we can use it the next day or week. Another fact in its favor is that it is always ready for use, except on very cold nights.

The electric light is, in my judgment, a more expensive light. I know there are those who deny this, but I think the most disastrous course ever pursued, by the men who put in an electric light into a town in competition with gas, is to announce to the public that the new light is cheaper than gas. Better, by far, stand securely upon the simple truth, that it is better light, but that it costs more to make it. Another thing, electric light is not in ordinary cases quite as certain as gas. A storm may blow down your wire; an armature or lamp may burn out; a half dozen unforeseen and unpreventable things may happen, and I think it is the better way to say so in advance to the customer.

Again, in all the smaller plants of the country the current must be used when it is made. We may be crowded to the very last atom of power for a very few hours in the day, and for a week or so in the year, and you must have power enough for that brief hour, even if you don't need it again for a year. A customer says: I would like your light for Christmas exhibition and New Year's trade, but I can get along with oil or gas the balance of the year. He does not think that the large investment of wire, engines, buildings, dynamos, etc., must be carried for the whole year, Summer as well as Winter, and a price made on an average of the whole year.

Yet there is no ground for fear, if we would be brave enough to rest our light upon its merits and not pretend that it is cheaper.

A few gas companies may have gone down in the contest, but not nearly so many as of the electric light companies. Their road is strewn with the debris of disaster and failure. This result is largely due, I think, to an overweaning confidence and zeal. Less hurry and more careful consideration of some of the important facts of the situation would have prevented much of the disaster.

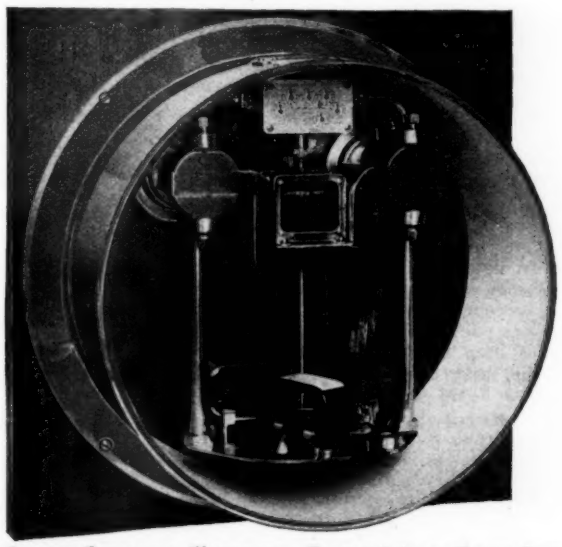
It has for years been one of the main arguments with sellers of electrical outfits and supplies, that the manufacture of electric current for its many uses was a source of great profit. Time has shown the folly of this statement. The electric light stands firmly upon one proposition; to wit, it is a better light than oil or gas. It will never cover the entire field of illumination so long as oil or gas can be made at so much less price.

Step into any room lighted with oil or gas, and you are at once made sensible of the fact by smell as well as sight. You may use the Welsbach lamp, which gives the ghastly pallor of death to all about it; you may disinfect or cleanse it with lime or any other substances; you may put the price at 50 cents per 1,000 feet, but you cannot get rid of the unpleasant fact that wherever gas or oil is burning, they devour the life-sustaining element of the atmosphere; they leave an odor which is not wholesome and almost irremovable.

Station Output Thomson Recording Wattmeters.

How to learn exactly the amount of electrical energy put out from a station has long been a problem with which the station manager has struggled. Hitherto the practice has been to have a special employé keep as careful a register as possible at stated intervals of the amperes and volts indicated at the different instruments. The human element being thus introduced, the possibility of error has been ever present, and it may safely be said that heretofore discrepancy between the registered and actual output has never been eliminated.

To furnish a mathematically correct instrument to measure the full output of a station, and at the same time automatically to record the result, the Meter Department of the General Electric Company has devised a new recording wattmeter known as the form "G." All electrical men are familiar with the well-known Thomson recording wattmeter, which, introduced not four years ago, has already become the standard recording meter throughout the world. It was, in fact, chosen, by the Commission of Awards at the Chicago Exposition as the standard instrument of its class, with which all others were compared. The new station output instrument is a development from this type, and although, of course, a much heavier instrument, retains all the principles of the present well-known recording meters.



THOMSON STATION RECORDING WATTMETER, FORM "G." FOR HEAVY CURRENTS.

The Form "G" recording meter is a series instrument, and takes the whole current through its field. This allows the elimination of all errors which might arise were a high capacity shunt employed. As an instance of the value of this fact, "G" meters constructed for 7,500 amperes work accurately and give excellent results, even under the comparatively small current of 500 amperes.

The field of the meter consists of a one-half turn made of a solid copper forging of high conductivity in the form of a wide-winged yoke having the wings of sufficient arm to permit of the insertion of the supporting studs. Within the "U" shaped part of this yoke revolves the armature actuating the dial mechanism. The shaft of the armature is, as in the other meters, prolonged and carries a copper disk which revolves between the jaws of three magnets set at the bottom of the meter.

The resistance in series with the armature is external to the meter. It is installed at the back of the switchboard and is there out of the way.

The meter is mounted directly on the switchboard, and is supported entirely by the heavy studs which pass through the material of the board and are secured by heavy nuts to the connections behind. The studs thus form the mechanical support and the electrical connections.

The cover of the instrument is of beveled plate glass set in a burnished brass flange and rim fitting snugly against the board, and is provided with a felt packing to exclude dust. All the metal parts of the instrument are brightly polished and impart to it a very handsome appearance.

As already mentioned, these meters have been devised for the measurement and record of the station output. They are intended for connection with each machine or each feeder, or a single large meter may be connected for recording the total output of an entire power or lighting station.

They are manufactured in capacities of 2,500, 3,750, 5,000, 6,250 and 7,500 amperes, the first, third and last being considered the standard sizes and for pressures of 100 and 500 volts. The 100 volt instruments have been designed for use on the three wire system, one meter being placed on each side of the line. The 500 volt meters are for use on railway systems or in stationary power plants.

In addition to the meters described above an arc station wattmeter for measuring the total output of an arc machine has also been devised. In this instrument the principles of the Thomson recording wattmeter have been retained, modifications being introduced to adapt it for use in connection with constant current circuits of high potential. The rheostat used with this arc station meter is a separate piece of apparatus to be installed in front or behind the board. It is designed for use under extremely high pressure (especial care being given to the insulation) and is mounted on a marble base.

The arc station meters are made in four sizes: 35 lights, 6.8 amperes; 35 lights, 10 amperes; 50 lights, 6.8 amperes; 50 lights, 10 amperes; and measure the output with accuracy.

The meters complete the line of General Electric station recording instruments. For the alternating system, there are the primary meters in capacities ranging up to 600 amperes at 1,000 volts or about 10,000 lamps. For the direct current systems for light, railway and power the form "G" meters, or larger meters of standard form, are employed; and for arc systems the arc station meter.

PRIMARY BATTERY TESTING.

METHODS AND APPARATUS OF THE GERMAN TELEGRAPH DEPARTMENT FOR FINDING COMMERCIAL EFFICIENCY.

At the November meeting of the Electrotechnical Society of Berlin, Mr. K. Strecker, one of the leading electricians of the German Telegraph Administration, described the methods and special apparatus used by the department for testing the commercial efficiency of batteries, more especially of that class commonly called "dry batteries."

As this is a subject of much interest and importance not only to manufacturers of batteries, but also to the thousands of people who are daily using voltaic cells for all purposes, it is thought that an abstract of Mr. Strecker's paper will be welcomed by the readers of the ELECTRICAL REVIEW.

In his introductory remarks, the speaker emphasized the necessity of distinguishing between a test made strictly for a scientific examination of a cell, and one that is carried on to find the commercial efficiency of the battery under test. To prevent any misunderstanding, it may be well to add that the scientific test of a battery primarily analyzes the exact chemical process which takes place in the cell, and the interdependence between the chemical and electrical work; on the other hand, a commercial test considers the cell primarily as a manufactured article whose efficiency must be ascertained for a definite commercial purpose.

Consequently, no universal rule for testing batteries can be established *á priori*, but each cell—according to the special work for which it has been designed—needs its special method of testing.

Again, it should be borne in mind that dry batteries are not constructed for continuous but intermittent electrical work, and our methods of testing should be selected accordingly.

As a rule, dry cells are manufactured to work through a definite resistance, another important point.

Manufacturers who desire to ascertain the efficiency of dry cells employ, as a rule, either of two methods:

1. The cell under test is connected to a vibrating bell. Account is then taken of the time the alarm continues to operate. Such method is permissible if the cell is used exclusively for that purpose, but whenever it is employed for other work that test becomes futile and meaningless.
2. The cell under test is joined first to a voltmeter, secondly to an ammeter. Ordinarily the voltmeter will give a correct indication of the electro-motive force of the battery, assuming that a sufficient resistance has been inserted in the working circuit, which should not be less than 20 ohms for dry batteries whose electro-motive force may amount to two volts.

It is thought that the reading of the ammeter is a reliable indication of the amperage, relying upon Ohm's law, *i. e.*, $C = \frac{E}{R}$; but the point is overlooked that the ammeter introduces an appreciable resistance, in some cases even exceeding that of the cell under test. Consequently the resistance of the ammeter should be taken into account. As a rule, however, the error caused by neglecting this factor is insignificant. Of much greater importance and magnitude is the fact that a short-circuited battery polarizes very rapidly, and that the average ammeter is not an aperiodic instrument, but consumes a certain time before the needle comes to rest. Thus the electro-motive force of the battery is less during the time the measurement is performed than it was on open circuit. Calling the reduced electro-motive force, e, g. the resistance of the galvanometer, we have

$$C = \frac{e}{R+g} = \frac{E-(E-e)}{R+g} = \frac{E}{R}\left(1 - \frac{E-e}{E} - \frac{g}{R}\right)$$

It is by no means unusual to find that the error caused by an uncorrected reading of the ammeter amounts to 20 per cent.

After an exhaustive discussion of the methods generally adopted for ascertaining the potential and internal resistance of batteries, Mr. Strecker describes the special bridge arrangement employed by the department. It is a slight change from Professor Kohlrausch's method, which is specially well adapted for measuring the

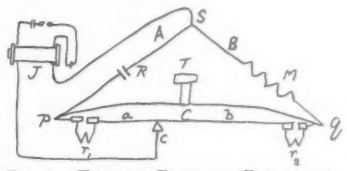


FIG 1.—TESTING PRIMARY BATTERIES.—MODIFIED KOHLRAUSCH METHOD.

resistance of quickly polarizing elements. In Fig. 1, A B are the two arms of a Wheatstone bridge, A containing the battery under test, and B a resistance coil M, say, of three ohms. C is a high resistance wire stretched between r' and r'', the former representing a resistance coil of 1.5 ohms, the latter one of one ohm. An inductorium J furnishes the alternating current necessary for producing sound in the telephone, which is connected in the bridge wire between points p and q. One side of the secondary is joined to S, the other carries at its end a contact device arranged to slide along the stretched wire. As soon as the sound in the telephone becomes inaudible, or at least as low as possible, equilibrium of current has been established in the bridge arms, and consequently we have:

$$R : M = r_1 + a : r_2 + b.$$

If the internal resistance of the battery under test is very small (for example, a secondary cell) plug r_1. The equation then reads:

$$R : M = a : r_2 + b.$$

If R is zero, a must be zero; in other words, the zero point of the graduated, stretched wire must be at point a.

If we desire to measure resistances up to three ohms, or R=3 ohms, then

$$3 : M = D : r_2$$

D standing for the entire resistance of the stretched wire.

Again, if we want to test the battery through a given resistance, say $M + r_2 + D = 5$ ohms, we shall have three equations with three unknown quantities, which may be solved in the following manner:

Making the resistance of the stretched wire one ohm, we have

$$D = 1 \quad \ldots\ldots 1$$
$$M + r_2 + D = 5 \text{ or } M + r_2 = 4 \quad \ldots\ldots 2$$
$$3 : M = D : r_2 \quad \ldots\ldots 3$$

Substituting in equation three the value of D, *i.e.* 1, we have

$$\frac{3}{m} = \frac{1}{r_2} = 3r_2 = M.$$

Substituting this value of M in equation 2, we have

$$3r_2 + r_2 = 4; \text{ or } 4r_2 = 4 = r_2 = 1 \text{ ohm},$$

and substituting this value in equation 3, we find

$$M = 3 \text{ ohms}.$$

If the wire D has been chosen to represent 1 ohm, and is one meter long, every scale division represents .001 of an ohm, and the apparatus becomes a very accurate ohmmeter.

For the measurement of larger resistances we unplug r_1, thus adding resistance to the measuring wire and may then measure resistances ranging from 2.25 to 7.5 ohms. Finally, should the resistance under test be very great (take for example a standard cell), plug r_2 and unplug r^1; we may then measure resistances ranging from 4.5 up to any desired amount.

Tests for the commercial efficiency of cells to be of real value must be made at stated intervals and continued for a long period of time. Having tried numerous devices, the department at last constructed the apparatus shown in Fig. 2, which is self explanatory. It may be stated, however, that the disk A, which is driven by clock work, contains a number of holes or perforations, s, into which can be inserted small studs, or pivots, and the mere insertion or removal of these studs enables the experimenter to close the battery under test for any length of time.

Of course, the relays, including all auxiliary apparatus and the batteries, are placed in a special receptacle from which heavy copper conductors lead to the testing instruments. Mr. Strecker states that using this arrangement, 40 batteries may be tested within one hour.

V. M. BERTHOLD.

ELECTRIC LIGHT FLASHES.

Frenchtown, Pa., is to have electric lights.

Mauston, Wis., will have electric street lights.

Seneca, Kas., will have a new electric light plant.

Robert Thirkell has bought the Clinton, Pa., electric light plant for $3,640.50.

A 20 per cent reduction in prices for electric light has been made at Bridgeton, N. J.

A $300,000 fire in Newark, N. J., damaged the plant of the Newark Electric Light and Power Company.

The Hartford, Conn., Electric Light and Power Company has just installed a 2,000 light Westinghouse alternator.

The Dolgeville, N. Y., Electric Light and Power Company have voted

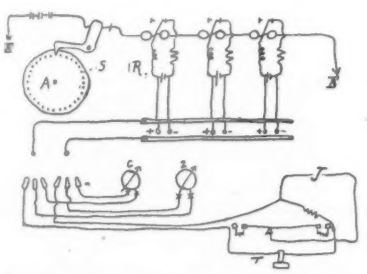


FIG. 2.—TESTING PRIMARY BATTERIES.—GERMAN TELEGRAPH DEPARTMENT METHOD.

to increase their capital stock from $25,000 to $50,000.

A bill has been introduced in the Michigan Legislature appropriating $25,000 for an electric light plant for the State capitol.

Linneus, Mo., citizens will raise $3,000 with which to purchase machinery to be attached to an engine of a local mill to furnish electric lights.

An electric light plant at Pierceville, N. Y., with which to illuminate Eaton, West Eaton and Morrisville, is proposed. The water power is abundant.

That the city of Chippewa Falls, Wis., will eventually purchase the plants of the Water, Light and Power Company is said to be practically decided.

John H. McAlvin has retired as treasurer of the Lowell, Mass., Electric Light Company. He received a vote of thanks for faithful service. His successor is W. H. Bent.

The Massachusetts Gas and Electric Light Commissioners have approved the issue of $19,000 new stock of the Malden Electric Company, instead of $94,900 as prayed for.

The Edison Electric Illuminating Company, of New York, makes the following comparative statement for January:

	1895.	1894.	Increase.
Gross.....	$166,953.05	$135,184.28	$31,768.77
Net.....	93,703.14	76,843.53	16,859.61

The people of Winchester, Mass., want a municipal electric light plant. A committee from the Town Club say it will cost $60,000 and a committee appointed by the town say $30,000 will pay for it—a slight difference.

All the bids for city electric lighting in Brooklyn, N. Y., for the ensuing year have been rejected, and new specifications will be issued. The old companies, it is expected, will now enter into sharp competition with the Edison company for the contracts.

Mr. Clyde C. Radabaugh, superintendent of the Charleston, Mo., Electric Light and Power Company, has issued a tasteful menu decorated with violets and yellow ribbon giving the prices his company charges for commercial and domestic lighting.

Messrs. Whiting, Hay and Apthorp, of the Ohio Penitentiary Board, in connection with Adjutant-General Howe, have been appointed a special committee to make preparations for the construction of an electric light plant in the penitentiary, in accordance with the appropriation of $22,000.

Vancouver, British Columbia, is having a scandal over a city electric lighting contract, and J. W. McFarlane, a prominent citizen of that town, has been arrested on the charge of bribing an alderman for $1,000 to vote to award the contract to the British Columbia Iron Works represented by McFarlane.

The Indiana Electric Light Association has been formed. The officers are: President, J. W. Roney, of the Richmond Light, Heat and Power Company, and Mr. Smith, of Union City, vice-president. The secretary is to be appointed by the president, and J. D. Edwards, who had been appointed secretary pro tem., was continued in the office until the president shall make an appointment.

Referring to the article recently published in the ELECTRICAL REVIEW, which described the proposed Jungfrau electric railroad, we note that on December 19, 1894, the Swiss Administration decided in favor of the plan by a majority of 25 to 4.

TELEPHONIC CABLES WITH DRY AIR CIRCULATION.

BY A. BARBARET IN "ANNALES TÉLÉGRAPHIQUES."

Telephone cables used for a long time past in Paris consisted of gutta-percha-covered wires protected with a covering of lead. Although modifications have been made from time to time, the following specification practically holds good:

The cable consists of seven pairs of wires, each wire consisting of three strands of copper 0.5 millimeters in diameter, and covered with gutta-percha to form a diameter of 3 millimeters.

The seven pairs are laid up together to form a cable, which is then covered with cotton tape, and finally with a lead covering 1.25 millimeters thick. The external diameter of the cable is 22 millimeters. The weight per kilometer is 1.070 kilogrammes, and the length of each section is 500 meters. The ohmic resistance of each conductor is 31.22 ohms at + 24° C., and the insulation resistance per kilometer varies between 200 and 2,500 megohms. The capacity per kilometer is 0.25 microfarads. These cables are easily laid, on account of their flexibility, and a faulty section can be replaced with facility.

Owing to the thinness of the lead covering, these cables do not last for more than eight or 10 years underground. Their cost is about 3,240 francs per kilometer, and is largely dependent on the price of gutta-percha. The main disadvantage of these cables is their high resistance and capacity, which renders them useless for long-distance telephony. It would be comparatively easy to diminish the resistance, but the capacity cannot be varied much, as this depends on the specific coefficient of gutta-percha.

For long-distance telephony Fortin-Hermann cables are largely employed, on account of their low capacity. The core consists of seven strands of 0.7 millimeters or of 0.5 millimeters, on which are threaded a number of paraffined wood beads, in the form of cylinders, eight millimeters long and four millimeters in external diameter. The wires are finally protected with an envelope of lead three millimeters thick. The external diameter of the cable is 29 millimeters, the length of each section 200 meters and the ohmic resistance of each conductor 13 ω at 124 degrees centigrade. The insulation resistance per kilometer is 1,000 megohms, and the capacity is 0.06 microfarad per kilometer; the figures obtained in general practice being better than the above specified figures. The insulation resistance depends on the dryness of the air in the cables.

The joints between the sections are made by means of ebonite sleeves having 14 grooves round the periphery into which the conductors are joined. This sleeve is then covered by means of a cylinder of ebonite in two halves, the whole joint being protected by a lead sleeve soldered to the ends of the cable.

These cables are fairly easy to lay, and the insulation resistance is easily maintained so long as there is no fault in the lead covering. Such a fault can be remedied by the process described below, and which is employed during the manufacture and the laying of Fortin cables, and also of paper and cotton insulated cables.

At the end of 1891 a Fortin cable used in Paris between the "Bourse" and the "Gare Montparnasse" had become defective, owing to portions of the lead covering having been eaten away by rats. This admitted moist air into the cable, and the insulation resistance fell to one megohm per kilometer. The hole in the lead covering was soldered up, but it was ascertained that in order to raise the insulation resistance to 100 megohms would necessitate the renewal of several sections. It was then thought that by removing the damp air the insulation resistance could be restored to its original value of 5,000 megohms.

A desiccator was employed consisting of two glass tubes containing 3.5 kilogrammes of sulphuric acid, and of a large tube with chloride of calcium at the top and with lime at the lower part, the lime being used for arresting all acid vapors. A water pump was employed as an aspirator, and, notwithstanding the ebonite plugs used at every joint of the cable, a gentle flow of air was obtained through a length of 5.2 kilometers. The insulation resistance had been much improved in this manner, when, by accident, some water from the pump was admitted into the cable.

This water was forced out by producing a pressure of 8 kilogrammes per square centimeter at one end, and a vacuum of 6.6 kilogrammes per square centimeter at the other end. A current of dry air was next passed for 88 hours. The insulation resistance was then found to be 600 megohms per kilometer in the section which had received the water. During this experiment the flask of sulphuric acid had increased by 600 grammes in weight. The insulation resistance was finally brought up to 12,500 megohms per kilometer, being better than when first laid.

As the ebonite plugs used at every joint were found to offer too much resistance to the passage of dry air, a hole of 8 millimeters in diameter was eventually drilled through the center of each plug.

The circulation of dry air in connection with these cables is now always obtained by pressure, and not by vacuum; there being the advantage of more easily localizing the leak in the lead covering, and of not drawing in moist air if there exist such a leak.

This process is also employed for paper or cotton insulated cables, it being necessary in this case to employ a higher pressure in order to cause the air to circulate.

The latest form of desiccator consists of six iron cylinders five millimeters thick, 200 millimeters in external diameter, and 1.20 meters high, closed at the ends by iron plates bolted to a flange. A grid is placed in each cylinder at a height of 0.2 meter from the bottom, and all the upper part is filled with chloride of calcium (about 30 litres per cylinder).

Each cylinder stands on an oak box, and is fitted at the lower end with a tap, for the purpose of running off any dissolved chloride of calcium. The last cylinder is not quite filled, a height of about 0.3 meter being packed with cotton wool, in order to filter the air of any dust.

The necessary pressure is obtained from the Popp Supply Company at five kilogrammes per square centimeter. As this is too high, a reduction valve is employed for reducing the pressure to about three kilogrammes.

All cables insulated with cotton or paper, without paraffine or other insulator, can be subjected to the above treatment, as was shown during tests on Fowler-Waring and Felton & Guillaume cables, the condition being that no obstruction should be offered at the joints to the flow of air, somewhat modifying the system of soldering the joints.

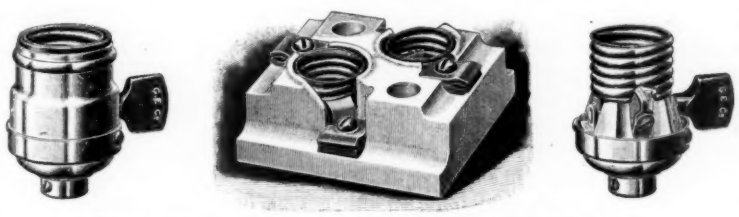
The author shows that the great advantage of this system is that a fault in the lead covering can be repaired without interruption to the service by merely circulating dry air through the cable, and soldering up the hole after having brought up the insulation resistance to the desired standard.

In the manufacture of Fortin cables a current of air is forced through the cable during the process of lead covering when the cable is hot. By this means an insulation resistance of 10,000 megohms per kilometer is easily obtained.

In the manufacture of such cables it does not matter much under what form the cellulose is used—whether as paper, wood or cotton—as the dielectric consists really of dry air, these materials being only used as a mechanical separation between the wires. For the sake of economy, paper could advantageously take the place of the wooden beads, and is less hygroscopic than cotton. The thickness of the lead covering should never be less than three millimeters; for cables with 27 pairs of conductors the thickness should be 3.25 millimeters, and for cables with 51 pairs 3.5 millimeters should be the minimum thickness.

It is advisable to protect lead-covered cables from the chemical actions of the soil by surrounding them with bitumen.

Air-insulated cables can also profitably be employed in telegraphy, although their capacity is not sufficiently high to prevent the effects of induced currents in cases where earth returns are employed. But by the use of a copper return these induced effects can be entirely eliminated, and great advantages obtained where rapid transmission is a consideration. These double-circuit cables would be cheaper than single-circuit cables insulated with gutta-percha. The author considers that air-insulated cables could also be advantageously employed for electric lighting and transmission of power.



GENERAL ELECTRIC COMPANY'S NEW CUT-OUT AND NEW SOCKET.

General Electric Company's New Lighting Appliances.

The General Electric Company has, within the past few weeks, placed on the market a new cut-out and a new socket embodying in both improvements of an important nature. The former, a double pole, single or double cross-over branch plug cut-out, is so constructed as to facilitate its attachment to the wires already placed, while holding the wires well apart where they cross. It is a very compact device, of the well-known plug fuse type, the fuse being held in a brass covered screw plug, which is inserted in the female screw shell secured to the porcelain. Replacement of the fuse entails no further labor than is involved in the unscrewing of the fuseless plug and the insertion of a perfect one, and it is this feature which renders the plug cut-out so valuable, especially in residences and places where fuses have to be cared for by unskilled persons.

The lamp socket is the outcome of a well-founded knowledge of the conditions which should be fulfilled by a first-class socket, and while embodying the best features of all preceding sockets, embodies also improvements which ensure the best results in practice. It is smaller than the well-known Edison socket, and in construction is extremely simple. The entire base is formed of one porcelain piece of conical shape, and so rigid perpendicularly that the possibility of short circuit between the working parts is practically nil. The key may be turned in either direction. The central connection for the lamp base is a well tempered contact spring against which the lamp is screwed and a good contact made, while the spring serves to prevent the lamp from wearing loose. The wires are connected as directly as possible, needless joints being avoided. The insulating collar between the screw shell and outside shell is firmly locked in place and extends one-sixteenth of an inch beyond the shell.

Every precaution has been taken to produce an appliance, the usefulness of which cannot be impaired by the ordinary carelessness of wiremen or fixture-fitter. And as in this particular alone it meets a demand, its success should be correspondingly great.

The porcelain used in these appliances is manufactured by the General Electric Company in its own porcelain works, at Schenectady, which were especially constructed for the production of porcelain, possessing the high insulating qualities for which the stringent conditions of the government specifications and insurance rules call.

LITERARY.

President E. Benjamin Andrews, of Brown University, begins in the March *Scribner* his "History of the Last Quarter-Century in the United States." That it is to be full of dramatic passages of the greatest popular interest is shown by some of the topics in this first instalment—the Chicago Fire, the Downfall of Tweed, the Ku-Klux Klan, Gould and Fisk's gold corner, and the San Domingo affair. The author says that in these articles "he is going upon a rapid excursion through vast tracts with frequent use of the camera, and not upon a topographical survey."

"Chimmie Fadden, Major Max and Other Stories," by Edward W. Townsend. Illustrated, 346 pages. Lovell, Coryell & Company, New York. Price, cloth, $1.00; paper, 50 cents. Sent postage free on receipt of price by the ELECTRICAL REVIEW Publishing Company, 13 Park Row, New York.

To readers of the New York *Sun* Chimmie Fadden, Miss Fannie and the Duchess, Major Max, Mrs. Max and the setter dog are no strangers. Such readers and others will be glad to know that Mr. Townsend's clever sketches with "Other Stories" have been collected in book form. Thus have these old friends and their adventures been saved for better things, let us hope, than the ephemeral popularity of literary efforts which appear in great daily newspapers. In the Chimmie Fadden sketches appear the best examples of the New York street Arab's dialect that have ever been written. The "langwudge" is as true to life as the adventures of the hero are amusing. Major Max is an army officer, whose family consists of the charming and companionable Mrs. Max and a setter dog of vast intelligence, who knows when to wink. Quite an up-to-date and ideal family life is exhibited in the Major Max stories. The other tales in the book are equally interesting. Anyone who makes the least attempt to keep abreast of current literature must read this book. Chimmie and the Major have been much discussed in polite society, and now they will be more talked about than ever.

"Street Railway Investments: A Study in Values," by Edward E. Higgins. Cloth, 102 pages, numerous tables and statistics. Price, $2.00. Sent postage free on receipt of price by the ELECTRICAL REVIEW Publishing Company, 13 Park Row, New York.

The author's investigations cover a period of three years, and his collected data on horse, cable and electric railway systems in cities of various sizes have been used as a basis on which to predict conservatively the probable limits of gross and net earning capacities under different conditions of traffic. Mr. Higgins, from what we know of his past experience, would seem to be well qualified for the task he has undertaken, and it is only fair to presume that he has drawn his conclusions without prejudice. Such data as he deals with cannot be obtained mathematically correct; hence any writer using it must call upon his individual judgment, not once, but many times. This the author admits doing, but his judgment should be better in this matter than those for whom the book is chiefly designed—intending investors in street railway properties. To such readers the book should be of great value, and none the less so because it is the only work on the subject.

Use of Copper-Zinc Traction Accumulators.

For the first time the new European accumulators have been employed by the traction company of the city of Hagen. Four cars are used, each affording room for 24 people and weighing seven tons. Below the seats there have been constructed long wooden receptacles capable of holding 44 elements each, eighty-eight batteries altogether. Fifteen horse-power motors supply the motive power. A special auxiliary device reduces the speed of the car without any loss of power. Another device permits the charging of the accumulator while the car is going down grades. The batteries are charged by a current which is brought to the charging rooms under a tension of 83 volts. The charge commences under a tension of 0.9 volt and is interrupted when the voltmeter shows one volt. It has been found useful to heat the cells during the period of charge to 50 degrees Celcius. So far the results achieved are said to be very satisfactory, and the further success or non-success of this practical trial of the copper-zinc accumulator will be carefully watched by all people interested in railroad transportation.

The "P. & B." Products.

There is no better known phrase in the electrical business than "P. & B." It is almost the first thing we learn about when beginning practical electrical work. The first "electrical" work done by the writer was painting wooden mouldings with "P. & B." insulating compound for use on the brick walls of a large building. These mouldings were nailed to the bare walls, and after the wires were laid and the mouldings capped, an expensive oak sheathing was laid on the walls. That was some years ago, and to-day there is no better job of interior wiring in any isolated plant in New England.

The pleasantest thing about "P. & B." is its standard of quality. If you used it for a certain purpose 10 years ago, and it was satisfactory, you can be morally certain that you will find it the same to-day—and that's a great comfort. You can use "P. & B." for almost "any old thing" that requires insulation and it will please you. Then there are "P. & B." armature varnish and insulating papers that are well known for their excellent qualities. "P. & B." compound is water, acid and alkali-proof and comes pretty near being fireproof. The Standard Paint Company, 2 Liberty street, New York, make and sell these products and the Metropolitan Electric Company, 186 and 188 Fifth avenue, Chicago, sells a lot of them in the West.

SOME MORE KIND WORDS.

WHERE HE GOT THE BEST RESULTS.

The following letter is from an esteemed western reader of this journal. As he did not authorize the use of his name we omit it, yet believe he would not object if it appeared in full:

TO THE EDITOR OF ELECTRICAL REVIEW:

I am pleased to see you are pushing the REVIEW.

I don't exactly know why, but it is a fact that I always had better results from advertising in the ELECTRICAL REVIEW than in any other paper.

This in face of the fact that our card was smaller in the REVIEW than in other papers.

I sincerely wish you the greatest success. —— —— ——.

Chicago, February 8, 1895.

NOT ELECTRICIANS, YET CAN'T GET ALONG WITHOUT THE "ELECTRICAL REVIEW."

TO THE EDITOR OF ELECTRICAL REVIEW:

We have been a subscriber to your valuable paper for some time and think we could hardly do without it, although we are not electricians.

We think it a valuable paper to anyone studying electricity to any extent. Respectfully yours,

C. A. JOHNSON & SON.

February 8, 1895.

APPRECIATES THE DIFFERENCE.

TO THE EDITOR OF ELECTRICAL REVIEW:

Find enclosed $3.00 for one year's subscription. Took the —— —— before, but prefer the ELECTRICAL REVIEW. Please send catalogue of electrical books. E. S.

Indiana, February 8, 1895.

A LATIN SAYING.

TO THE EDITOR OF ELECTRICAL REVIEW:

Judging from a careful examination of the electrical journals, I verily believe that —— quietly is mumbling the old Latin saying: "Oh! if I had only shut my mouth I would have remained a philosopher!"

The last issue of the ELECTRICAL REVIEW, as usual, is a highly creditable piece of work. I have been studying the volumes of the REVIEW from its first issue, making abstracts and notes. Believe me, I have learned a good many interesting things by such perusal. I submit myself

A BOSTON READER.

February 10, 1895.

Another Flutter From the "Wounded Bird."

The W. J. Johnston Company, Limited, under date of February 9, 1895, writes as follows to a number of advertisers:

"Although a *former advertiser* with us, and a card of yours *still appears in other electrical journals*, you have at present no announcement of any kind in the —— ——. Yet this is the pioneer," etc., etc.

The first sentence above quoted, italicised by us, is no doubt true. Confirmatory evidence is piling up each week.

The last sentence is not true. This is proven by dates given in the ELECTRICAL REVIEW, January 23, 1895, which can be verified by reference to newspaper files. Does anyone now believe the statement of W. J. Johnston, that his present paper—the lone surviver of his four—is the "pioneer?"

"HERE'S RICHNESS."

AN IMPERTINENT CIRCULAR POINTEDLY ANSWERED.

The series of "Questions and Answers" appearing below were sent to this office by a Pennsylvania reader of the ELECTRICAL REVIEW who is engaged in street railroading. We presume these answers were returned to the office sending out the questions; if not, our original copy will be forwarded on request. The answers are so happy, discerning and comprehensive that we publish them, and trust our readers will pardon the digression. The circular, as its prying interrogations prove, is from the office of the "*Wounded Bird*," where a pale-green, ex-pioneer, padded, puddin'-head periodical is published:

Question—What is your opinion, briefly, of —— —— report of the Brooklyn strike?

Answer—Good rehash of the daily paper reports.

Q.—In what electrical or street railway journal did you read the first report of the strike?

A.—The ELECTRICAL REVIEW.

Q.—In what paper did you find the best report?

A.—The ELECTRICAL REVIEW.

Q.—What do you think of the information regarding the proposed extension of street railway lines, published in the February 2d —— ——?

A.—It's of no value to and will not be read by street railway managers.

Q.—What other articles in that issue interested you particularly?

A.—None.

Q.—Are you a subscriber of the —— ——?

A.—No. Don't need to be.

Q.—Are you a reader of the —— ——?

A.—Used to be, but prefer to keep abreast of the times by reading the ELECTRICAL REVIEW.

Q.—Do you take it regularly through your newsdealer, or merely see the paper occasionally?

A.—Receive from one to five "sample copies" weekly.

Q's.—
- Are you a subscriber of the *Street Railway Journal*?
- Are you a subscriber of the *Street Railway Review*?
- Are you a subscriber of any electrical paper other than the ——; if so, what one or ones?

A.—You could as consistently and with as much propriety ask: "Are you a Democrat or Republican; Presbyterian or Baptist?"

Q.—Do you consider that articles published in the —— —— are of practical value to those engaged in the street railway business?

A.—No.

Q.—Are they of practical value to you?

A.—No.

Q.—In what respect do you think the —— —— might be improved, from the standpoint of a street railway manager?

A.—By an entirely new management in both editorial and business departments.

Q.—Are you willing to assist us to improve it, and what can you do to co-operate with us in this respect?

A.—Only on condition that you abandon your self-appointed mission of seeking to be the Alpha and Omega of electrical journalism.

"GENERAL REMARKS."

Ans.—Dictatorships have all been short lived, as Mr. Debs will doubtless bear evidence. There is no more need of or room for a dictatorship in electrical journalism than in railway strikes or governments. If you'd spend the energy in the line of improvements that you waste in abusing contemporaries and withdrawing advertisers the —— —— might, in time, become a passably readable sheet.

When filled out, please return to the —— ——, 253 Broadway, New York.

The Power Plant of the Baltimore and Ohio Belt Line Tunnel.

Probably no electric plant, or electric experiment on a large scale, has attracted more attention than the Baltimore and Ohio Railroad tunnel plant in Baltimore, which will go far toward deciding the question as to whether electric traction is adaptable to steam railways as a substitute for steam locomotives, and also as to whether electricity is the best motive power for rapid transit in tunnel plants.

The Belt Line Road, as it is termed, is but a short cut, connecting the main tracks of the Baltimore and Ohio Railroad at two points, and its object is to avoid a long curve about the city. This is calculated to save from 20 minutes to half an hour in the running time between New York and Washington, and besides it will enable the Baltimore and Ohio Railroad Company to place one station near the present Union Station of the Pennsylvania Railroad, and a second one in the very heart of the business center of the city.

The Belt Line Road is about seven miles long. It begins near Bayview, to the east of the city, runs several miles through deep cuts along the northern edge of the city, until it swerves around to the Jones Falls embankment, west of Oak street; it crosses the valley of this stream, the track of the Pennsylvania Railroad and the Baltimore and Lehigh Railroad on a large bridge, and a short distance beyond this it enters the tunnel which follows Howard street through the city to the present Camden Station.

The tunnel is 7,430 feet, a little less than a mile and a half long, and it cost the Baltimore and Ohio Railroad Company between $7,000,000 and $8,000,000.

The motive power is furnished from one station located near the end of the tunnel. This power house is equipped throughout by the General Electric Company, who are making the test of electric traction at their own expense, and if it proves in every way successful, the Baltimore and Ohio Railroad Company will purchase the plant complete from them.

In addition to the traction plant an electric lighting plant is found here which will supply about 2,000 incandescent lamps, which are placed throughout the tunnel. As there will be no smoke in the tunnel, it is intended to paint its interior white, and when illuminated by the electric lights it will not be necessary to light the lamps in the cars of passing trains, as the passengers will find it almost as brilliant inside the tunnel as outside in the daylight.

The generators will be driven by Armington & Sims engines, and the steam will be furnished from improved Root water-tube boilers. The boiler room of this plant is most interesting and includes the most modern appliances.

Twelve Root boilers are found arranged in six batteries; three batteries on each side of the room. Each of the two flues, which run along the opposite walls, back of the boilers, carry the heated gases to economizers, which rob the gases of their heat, and by this means, raise the temperature of the feed water.

The gases then pass into a fan of the Sturtevant pressure pattern, which expels them through a short stack into the air. This fan establishes an induced draft, causing the air to pass rapidly through the grate bars and coal, thus promoting combustion more or less rapid, according to the speed of the fan, which is regulated by the demand for steam on the plant.

A coal and ash handling device carries the coal direct to each of the boilers, where it is needed, and it also carries the ashes away from the ash pits.

As the General Electric Company are relying entirely upon the success of this plant for their sale of it to the Baltimore and Ohio Railroad Company, they naturally were obliged to exercise the greatest care in their selection of all the appliances, and to illustrate this point, in the case of the boilers, they did not place their order with the manufacturers until after they had thoroughly tested them in two of their plants in Lynn, Mass., which are equipped with this make of boilers.

The "Perfection" Dynamo Brush.

The "Perfection" dynamo brush, it is claimed, overcomes in a marked degree the tendency to spark at the point of contact with the commutator. It is the invention of Mr. J. W. Dickey, and is made of woven copper wire cloth cut on the bias and so wound that no solder is required except at the end which is never in use. The method of winding is novel and produces flexibility. The patent of February 5, 1895, covers the insertion of a shorter piece of wire cloth in reverse position on the main blank

THE "PERFECTION" WOVEN WIRE DYNAMO BRUSH.

which produces even size throughout the length. This is especially required in long brushes, and is the vital part of the brush. Owing to the good work and universal satisfaction expressed by users of this brush, the makers have given it the name of the "Perfection." The manufacturer is Chas. E. Chapin, 136 Liberty street, New York.

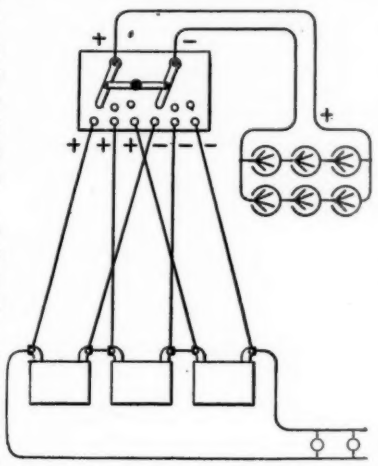
Cotton States and International Exposition.

General J. R. Lewis, secretary of the Exposition Company, has made a careful estimate of the amount of space taken and applied for, and his calculation is that every foot available will be covered by applications within the next 60 days. The applicants are located in all parts of the United States and Europe.

Berwyn, Pa., is to be lighted by electricity.

Storage Batteries Charged by Gravity Batteries.

Mr. E. C. Drews, of The Dalles, Oregon, describes in the *Scientific American* a method he uses of changing storage batteries by gravity batteries. The accompanying illustration



STORAGE BATTERIES CHARGED BY GRAVITY BATTERIES.

will elucidate the following description of Mr. Drews' method:

"I have three storage batteries composed of five plates each (plates six by eight and a half inches, perforated, and filled with red lead for the positive and litharge for the negative). I use six Crowfoot batteries for charging.

"The Crowfoot batteries are connected three in series and two in multiple arc. The storage batteries are connected in series, and each battery is connected on a binding screw of a three-point pole-changing switch with the Crowfoot battery. The switch is moved one point every 12 hours, so that each battery gets its supply of current. These batteries have been in use for a year and a half, and I have not had any trouble with them, excepting when the Crowfoot batteries had to be renewed.

"I am at present using two lamps of two candle-power, and the longest time that I have used them at one time was three hours."

General Electric Company at the Cleveland Convention.

The exhibit which will be made by the General Electric Company at the Cleveland Convention will be one of exceptional interest to all engaged in the electric light and power field and interested in the progress which has been made in the art during the past year.

The headquarters of the company will be located in the banquet room of the Hollenden, and its interests will be under the care of the following gentlemen, members of the company's staff:

From Schenectady—Messrs. S. D. Greene, J. R. Lovejoy, E. W. Rice, Jr., W. L. H. Emmet, M. O. Blackwell, H. C. Wirt; from Boston—Messrs. F. M. Kimball, C. D. Haskins, H. A. Harthen; from Cincinnati—Mr. W. F. Hays; from New York—Mr. T. Beran; from Nashville—Mr. H. M. Carson; from Chicago—Messrs. B. E. Sunny, Dr. L. Bell, F. N. Boyer; from St. Louis—Mr. G. F. Rosenthal; from Harrison, N. J.—Messrs. A. D. Page and Wilson S. Howell.

The exhibit will be located at the Canal street station of the Cleveland Illuminating Company, which company has kindly consented to furnish the necessary facilities for the operation of the machinery. The exhibit will consist first of a working demonstration of the new monocyclic system of electric light and power distribution recently developed by the General Electric Company. In detail, this will consist of a 230 volt four pole 50 kilowatt 575 revolution direct current motor of the latest type, which will be run by current taken from the Cleveland company's circuits and has been installed to operate the plant hereafter described. Belted to this motor will be a monocyclic eight pole 60 kilowatt 900 revolution 60 cycle generator, the current from which will operate a 15 kalowatt induction motor making 900 revolutions per minute. This in turn will be belted to a four pole nine kilowatt 350 revolution direct current dynamo, furnishing current to a load of incandescent lamps and Thomson '93 incandescent circuit arc lamps.

The current for the induction motor at 1,040 volts primary will be taken from the monocyclic generator to two of the General Electric recently designed type G 50 cycle transformers of seven and one-half kilowatts capacity each, and will thence be brought to the motor. In addition the monocyclic generator will have as a load a 1,000 watt and a 15,000 watt type G transformer, with the secondaries connected to a suitable lamp load.

To the 1,040 volt primary circuit taken from the generators of the illuminating company will be connected a 20 kilowatt 125 cycle transformer. A three wire secondary will run from this and furnish current to 104 volt lamps. In the primary circuit a station primary Thomson recording wattmeter will be connected. The secondaries will be loaded to their capacity with incandescent lamps, Thomson '93 alternating arc focusing lamps, Thomson induction fan motors, etc. The currents on the secondaries will be measured by Thomson three wire and two wire motors.

Current from the 1,040 volt circuit will also be taken for an exhibit of the General Electric alternating street system, consisting of 50 series lamps of three and one-half amperes, the sockets of each being provided with the automatic paper cut-out.

The working exhibit will be further augmented by a 12 inch hand controlled search-light, which will probably be operated at some nearby roof.

The appliances exhibit will consist principally of samples of the latest devices put out by the General Electric Company. These will comprise cut-outs, switches, insulators, etc., showing the excellence of the porcelain of its own manufacture; a full sample board of the new punched clip switches, showing among others those devised for 500 volt circuits; samples of the new key and keyless sockets.

Altogether the exhibit which the General Electric Company will make will not only be comprehensive, but will prove of more than ordinary interest to all those anxious to keep themselves thoroughly posted on the latest and most approved appliances, as well as the most recent developments in electrical practice.

HISTORY OF THE GAS ENGINE.

BY CHARLES QUAST.

The economical production of motive power has long occupied the minds of engineers and scientists, and has resulted in the almost exclusive use of the steam engine, which, although perfect as a machine, has an efficiency of working fluid so low as scarcely to be regarded as satisfactory and final.

The main cause of the low efficiency of the steam engine is to be found in the employment of a fluid which has a very high specific heat, and which requires to have its physical state changed before it can be made to convert the heat expended upon it into mechanical work. As the heat which is expended in causing the change of physical state from this liquid to a vapor is about six-tenths of the whole heat of evaporation, and is largely rejected by the steam into the exhaust, many attempts have been made to use liquids of lower specific heat, and requiring less heat for evaporation. Of these, ether, carbon bisulphide and mercury have been used alone or in conjunction with water, but, by reason of the cost of the material, these processes have not been commercially successful. Other attempts, based upon a truer insight into the problem requiring to be solved, have been made by the use of a gas as a medium for the transfer of heat, thus avoiding the loss incident to the use of a liquid. The gas which has been most frequently used is atmospheric air, and, as it is practically a permanent gas, it is so far admirably adapted for the purpose. Its slow specific heat, however—which is about one-sixth that of water—renders it necessary to work at high temperatures if much energy is to be developed.

In the first hot-air engines a fire was applied to the exterior of a cylinder containing air, and another cylinder was provided, into which the heated air was allowed to expand, propelling a piston as in a single acting steam engine. Very few of these engines have been brought into practical operation, owing chiefly to the difficulty of obtaining a sufficiently rapid convection of heat to and from the mass of air employed, and to the necessity for using a more bulky cylinder than is required for a steam engine of the same power and with the same maximum pressure. The diffusion of heat in a gas is much slower than in a liquid, and, accordingly, the temperature of the heating cylinder had to be maintained much higher than that of the working fluid, with the result of failure, due to the great wear and tear of the heating cylinder and the valves connected therewith.

In the air engines the efficiency of the working fluid was 0.25, while the efficiency of the furnace was nearly 0.4, making a resultant efficiency of the fluid and furnace of 0.1, which is about the same as that of a modern steam engine. To overcome the slow heating of the air when in mass has been the object of many inventors, and a type has been proposed with a closed furnace, and the air forced through the furnace, keeping up the combustion, the hot products going to the motor cylinder and there doing work. An engine of this kind was made and worked experimentally, but the cylinder, piston and valves were found to be so rapidly destroyed by the intense heat and the dust from the fuel that no attempt was made to bring it into practical use.

The most recent development of air engines employing internal combustion is that known as the gas engine. In this type of engine the working fluids used are practically perfect gases, and the diffusion of heat through the mass is obtained by the use of a combustible gas in conjunction with air. The intimate contact of the combustible components with the air to be heated is so complete that the diffusion of the generated is rapid and immediate.

Any machine converting heat into work or mechanical energy is termed a heat engine, and may have its action investigated by a reference to the principles of thermo-dynamics. These principles are based upon the theory of heat, which regards the immediate cause of the phenomenon of heat as motion, and the laws of its communication as precisely the same as the laws of the communication of motion. The first law of thermo-dynamics is this: "Heat and mechanical energy are mutually convertible, and heat requires for its production, and produces by its disappearance, mechanical energy in the proportion of 772 foot pounds for each unit of heat." The second law of thermo-dynamics is this: "It is impossible for a self-acting machine, unaided by any external agency, to convey heat from any portion of matter to another at a higher temperature." The measure of the greatest possible efficiency between given temperatures in any heat engine may be determined by a principle laid down by Sadi Carnot in the year 1824, which is that the ratio of the amount of work done by a perfect heat engine to the work expended upon it depends only on the constant temperatures at which heat is received and at which it is rejected, and is independent of the nature of the intermediary agent or working fluid. By this relation we shall be able to ascertain how far our actual engines deviate from the maximum efficiency assignable between the working limits of temperature. By comparing the work given out in the working cylinder, as recorded on an indicator diagram, with the maximum efficiency between given temperatures, we are able to find out the loss due to radiation, conduction or exhaust waste.

In a steam engine of large size, designed and worked in the most approved manner, two pounds of coal are required per hour for each indicated horse-power, whereas gas engines are run on less than one pound of coal. The efficiency of the fluid in a steam engine is about one-sixth, and is obtained by comparing the work done with the heat contained in the steam when admitted into the working cylinder.

From this brief consideration of the action of the steam engine we gather that the causes of its low efficiency are to be found in the unsatisfactory way in which the chemical action is conducted for the generation of the heat, and the unsuitable nature of the intermediary agent—water. To obviate these objections, repeated attempts have been made to construct an engine in which the heat shall be supplied by the combustible matter within the motor cylinder, and in which the intermediaries are permanent gases. Petroleum vapor, gasoline vapor, producer gas and natural gas have been used as the combustible element, with air in suitable proportions to act not only as a supporter of combustion, but as a diluent to modify the intensity of the resultant action.

The first engine embodying the use of these gases, which can lay any claim to notice, is one invented about the year 1863 by M. Lenoir. In this motor, air and coal gas in proper proportions are introduced into a cylinder, the admission is cut off, and the mixture exploded by electricity. The explosion causes a sudden increase of temperature and pressure, the gaseous mixture expands, driving the piston before it until the out-stroke is completed, and is then expelled during the return stroke. The irregularity of the ignitions, together with the large quantity of gas required, prevented the extensive adoption of this motor. The maximum pressure in some cases was obtained near the end of the stroke, just before opening the exhaust port, instead of being at the beginning of the stroke.

Since the later date nearly 700 patents have been taken out, and from an examination of these it would seem as though there were nothing further left to invent; nevertheless, each year gives rise to ideas that are new in their application, even if not novel in themselves. Such efforts cannot fail to result in a radical change of the former plans. Up to 1860 the various inventors may be said to have worked in ignorance of one another's doings, and their designs clearly show that their ideas were original with themselves, and that their efforts were directed, not to the improvement of previous inventions, but to the search after combinations which they supposed to be new.

But when the first gas engines were got practically to work the new ideas followed the current of the time. The inventors who followed Lenoir set themselves to improve the double-acting engine; now they are endeavoring to apply the four-cycle plan of Beau de Roches. Is this arrangement likely to be final? Will no better plan be discovered for rendering the gas engine a successful rival of the steam engine? As yet it is impossible to answer so intricate a question, but pending some radical changes, it is possible to improve existing engines, and to simplify their construction and working.

Until very recently the gas engine has been specially applied where only small power is required; its application for such powers as have hitherto been considered the province of steam is reserved for the future. A rapid examination of the most important inventions since 1791 will enable an idea to be formed of what has already been done and of what still remains to be accomplished. At that date gas was not an industrial product, and accordingly, "John Barber" described what he considered the best processes for its production. He proposed to distill coal, wood, oil, or other combustibles in a retort, and then by means of a pump to inject the product into a cylinder where explosion takes place. A second pump injects air in suitable proportions, and ignition is effected by the flame of a match or candle. To avoid excessive heating, he proposed the injection of water by a pump. Although Barber's machine could never have been a practical success, it is interesting as the first idea of an engine driven by explosive gas.

The fundamental idea of M. Beau de Roches is thus clearly seen to consist in the compression of the gaseous mixture to the greatest extent practicable before ignition. Manifestly, the only way to do this is to use a single cylinder, first, on account of the advantage of having as large a one as possible, and, next, to minimize the resistances of the mixture. Consequently, for one end of the cylinder, the following sequence of operations takes place during four consecutive strokes—inspiration during an entire stroke, compression during the second (return) stroke, ignition at the dead point and expansion during the third stroke, expulsion of the burnt gas during the fourth (return) stroke.

This engine, it is claimed, fulfills the condition of the largest possible cylinder, and the still more important condition of initial compression. Moreover, the speed of the piston in proportion to its diameter is the greatest possible, since the work usually performed in two strokes is accomplished in one. In 1863 Mr. Hugon brought out his motor, in which ignition was effected by a gas flame controlled by a slide. The arrangement was ingenious, but the motor had only a moderate success.

Thus briefly stated, the most recent investigation into the working of the gas engines, not because it very materially alters the greatest possible efficiency, but because it shows the complex chemical action which will have to be borne in mind in any attempt at improved working. The total heat given to the fluid is the same whether dissociation takes place or not, but the way in which the heat is supplied and the range of temperature are effected by it. The maximum efficiency of a motor using 22 cubic feet of gas per hour per indicated horse-power—employing a mixture of one of gas to 12 of air, compressing before ignition, and expelling the products of combustion at the usual temperature; viz., 430 OC.—is 0.74, being a maximum efficiency four and one-half times that of a good steam engine.

New Jersey Trolley Consolidation.

Trolley lines from Paterson to Jersey City, N. J., built and to be built under franchises already obtained, have been absorbed by a corporation to be known as the New Jersey Electric Railway Company. The lines absorbed were known as the Morrisee system. On February 11 the new corporation gave a mortgage for $3,500,000 to the Mercantile Trust Company, of New York, as trustee for the stockholders. The certificate of incorporation has been filed in Passaic, Bergen and Hudson counties, the counties through which the roads run, and the mortgage will be recorded in each county.

Suit for Infringement of Telephone Patents.

The Interior Telephone Company, of New York (who handle the Colvin system), on February 12 brought suit in the United States Circuit Court for the Southern District of New York against the Tucker Electrical Manufacturing Company, of 14 Whitehall street, New York, and against James R. Strong, president, and Thomas McCoubray as individual co-defendants, for the infringement of patents Nos. 5.3,305 and 524,524, granted to Frank R. Colvin and owned by the Interior Telephone Company.